Engineering Library

JUL 2 1930

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CXLIX.—No. 3884] LONDON: FRIDAY EVENING, JUNE 20, 1930 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

Montreal Harbour Bridge. (P. 676)
THE ENGINEER, 20 - 6 - 30.

The Automatic Stabilisation of Ships No. XII. (P. 692)
THE ENGINEER, 20 - 6 - 30.

The Training of an Engineer. (P. 678)
(F. W. BURSTALL.) THE ENGINEER, 20 - 6 - 30.

Propelling Machinery of the North German Lloyd Liner "Bremen." (P. 684)
THE ENGINEER, 20 - 6 - 30.

Electricity Supply in Great Britain. (P. 690)
THE ENGINEER, 20 - 6 - 30.

Report of the Departmental Committee on Area Gas Supply. (P. 685)
THE ENGINEER, 20 - 6 - 30.

Free Wheel and Sprag for Motor Vehicles. (P. 693)
THE ENGINEER, 20 - 6 - 30.

'Prentices and College Workshops. (P. 689)
THE ENGINEER, 20 - 6 - 30.

INDEX TO ADVERTISEMENTS, PAGE 99.

PUBLIC NOTICES

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Thursday, 3rd July, 1930, for LOW-PRESSURE HOT WATER HEATING at the Post Office Radio Station, Rugby.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 5237

The Director-General, India Store Department, Belvedere road, Lambeth, London, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—TWO TANK ENGINES, 4-6-4 type, metre gauge.
SCHEDULE 2.—TRANSFORMERS, 70, 20 and 15 kVA., with Motors and Switchgear.

Schedules due as follows :—
Schedule 1, 11th July, 1930.
Schedule 2, 16th July, 1930.
Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each schedule. 5245

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—

SUBSTATION PLANT for the Uhl River Hydro-electric Project, comprising :
SECTION 1.—Power Transformers.
SECTION 2.—Synchronous Condensers.
SECTION 3.—Switchgear.
SECTION 4.—Oil Filtration and Storage Plant.
SECTION 5.—Cranes.

Tenders due Thursday, 14th August, 1930.
Forms of Tender available from the above at a fee of £4, which will not be returned.
Tenders will be considered for any one or more of the Sections separately. 5244

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/1930.—ASSISTANT ENGINEERS REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary, 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No Income Tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtain such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case or have completed articles with a Civil Engineer of good standing, and have passed Sections A and B of the examinations for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of Civil Engineering under a qualified civil engineer.

M/2280.—DRAUGHTSMAN REQUIRED for the SURVEY DEPARTMENT of TANGANYIKA TERRITORY, for 20 to 30 months' service, with possible extension. Salary, £372 per annum, rising to £480 per annum by annual increments of £18. Outfit allowance of £30 on first appointment. Free quarters and liberal leave on full salary. Candidates, 25 to 35 years of age, must be neat and accurate Draughtsmen and Printers, used to large-scale and topographical work; have had experience in Plotting Surveys from Field Notebooks. Must be well up in Calculations used in Surveying, and have a knowledge of Surveying Instruments and Operations. Must be experienced in Survey Drawing-office Work, Methods, and Routine, and in Reproduction Processes for Plans and Maps. Knowledge of Lithography and the Vandyke Process is desirable.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 5251

The Government of the PUNJAB invite APPLICATIONS for an APPOINTMENT of ASSISTANT EXECTIVE ENGINEER in the Punjab Public Works Deparment, Hydro-Electric Branch. Candidates should be between 25 and 37 years of age, and should possess a knowledge of and experience in Driving and Lining Tunnels in Water-bearing Rocks. Some knowledge of Drilling with Compressed Air and Electrically Driven Hauling equipment would be an advantage. The possession of a recognised Civil Engineering Degree or Diploma will be taken into consideration.

Agreement for two years and six months. Pay in accordance with an age scale, e.g., age 25, Rs. 475 a month, plus overseas pay Rs. 150 a month; age 30, Rs. 625, plus overseas pay, £25; age 37, Rs. 975, plus overseas pay £30. (Approximate sterling equivalents at current rate of exchange, £562, £862, £1237 per annum.) Provident fund. Free first-class passage to India and return passage on satisfactory termination of agreement. (Overseas pay and return passage admissible only to an officer of non-Asiatic domicile.)

Further particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, India House, Aldwych, London, W.C. 2. Last date for the receipt of applications, 30th June, 1930. 5218

Civil Service Commission.
FORTHCOMING EXAMINATION — PROBATIONARY ASSISTANT ENGINEERS in the Engineering Department of the Post Office (20-25, with extension in certain cases).

Regulations and particulars, together with the forms on which applications must be made, will be sent in response to requests (preferably by postcard), addressed to the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1, giving the title of the situation. The latest date for the receipt of application forms is 10th July. 4994

Department of Scientific and Industrial Research.
APPLICATIONS are INVITED for JUNIOR ASSISTANTSHIPS at the NATIONAL PHYSICAL LABORATORY.

Candidates should have a good Honours Degree in Metallurgy, Engineering or Physics, preferably with some technical or research experience. The scale of pay for a Junior Assistant is £175-15-£235 plus Civil Service bonus (total at present rates £266-£342). There are prospects of promotion to higher grades. Superannuation provision is made under the Federated Superannuation System for Universities.

Application must be made on a form to be obtained from the DIRECTOR, National Physical Laboratory, Teddington, to whom it should be returned not later than June 30th, 1930. 5190

War Office.
DIRECTORATE OF MECHANIZATION.
APPLICATIONS are INVITED for the POST of CIVILIAN MECHANICAL ENGINEERING ASSISTANT to advise on Designs. The post is temporary and subject to one month's notice on either side. The scale of pay is £600 per annum inclusive. Candidates should hold a University Degree in Mechanical Engineering or similar qualification and have had practical knowledge and experience of Modern Internal Combustion Engines, and, if possible, of Compression Ignition Engines. A practical knowledge of Transmission Systems is also desirable.

Candidates must be natural born British subjects, and, unless they have served in the armed forces of the Crown during the Great War, the children of parents who are both natural born British subjects.

Preference will be given to those who have served in His Majesty's Forces during the Great War.

Form of application can be obtained from the PERMANENT UNDER SECRETARY OF STATE FOR WAR (C. 4a), The War Office, Whitehall, S.W.1, and must be returned complete on or before July 7th, 1930. 5248

PUBLIC NOTICES

MANCHESTER MUNICIPAL
COLLEGE OF TECHNOLOGY.
Principal :
B. MOUAT JONES, D.S.O., M.A. (Oxon).

UNIVERSITY OF MANCHESTER
(FACULTY OF TECHNOLOGY).
DEGREE COURSES IN TECHNOLOGY.

The Prospectus gives particulars of the courses leading to the Manchester University Degrees (B.Sc. Tech., M.Sc. Tech., and Ph.D.) and Certificates in the Faculty of Technology, in the following Departments :—

MECHANICAL ENGINEERING
(Prof. Dempster Smith, M.B.E., M.Sc. Tech., M.I.M.E.).
ELECTRICAL ENGINEERING
(Prof. Miles Walker, M.A., D.Sc., M.I.E.E.).
MUNICIPAL ENGINEERING
(G. S. Coleman, D.Sc. Eng., A.M. Inst. C.E., A.M. Inst. M. and Cy. E., F.R. San. I.).
APPLIED CHEMISTRY, including General Chemical Technology, Metallurgy and Assaying, Fermentation Processes (including Brewing), Electro-Chemistry, Photography, Colouring Matters, Foodstuffs and Fuels
(Prof. James Kenner, D.Sc., Ph.D., F.R.S.).
TEXTILE CHEMISTRY (Bleaching, Dyeing, Printing and Finishing), Paper Manufacture
(F. Scholefield, M.Sc., F.I.C.).
TEXTILE TECHNOLOGY
(Prof. W. E. Morton, M.Sc. Tech.).
INDUSTRIAL ADMINISTRATION (Post-Graduate Certificate Course)
(J. A. Bowie, M.A., D.Litt.).

Prospectus will be forwarded free on application to the REGISTRAR, College of Technology, Manchester. 5151

Borough of Acton.
SEWAGE PUMPING STATION.
CAST IRON RISING MAINS.

The Town Council invites TENDERS for the CONSTRUCTION of 42in. and 36in. diameter CAST IRON RISING MAINS and other INCIDENTAL WORKS at the Sewage Pumping Station, Warple Way.

Specification, bills of quantites, form of Tender and other particulars may be obtained upon application to the Borough Engineer, W. G. Cross, Assoc. M. Inst. C.E., on payment of a deposit of £2 2s., which will be returned on receipt of a bona fide Tender and the return of all loaned documents.

Sealed Tenders, endorsed "Tender for Rising Mains, Pumping Station," addressed to the undersigned, must be delivered on or before 3 p.m., 14th July, 1930.

The Town Council does not bind itself to accept the lowest or any Tender and canvassing in any form is prohibited.

JOHN MORGAN,
Town Clerk.
Municipal Offices, Acton, W. 3,
17th June, 1930. 5241

PUBLIC NOTICES

Royal Borough of Kingston-upon-Thames.
TECHNICAL COLLEGE AND SCHOOL OF ART.

WANTED, for Session commencing September, 1930, an INSTRUCTOR for EVENING CLASSES in ELECTRICAL ENGINEERING.

Salary in accordance with the Surrey County Scale for Instructors of Evening Classes in Technical Institutes.

Applications should be made on forms to be obtained from the undersigned.

H. T. ROBERTS, B.A.,
5247 Principal.

In the matter of LETTERS PATENT granted to WALTER JONES and JONES and ATTWOOD, Limited,

(1) bearing date the 4th November, 1914, and numbered 21976 of 1914 for the invention of "Improvements in or connected with the Purification of Sewage and Analogous Liquids."

(2) bearing date the 19th November 1914 and numbered 22736 of 1914 for the invention of "Improvements in and connected with the Purification of Sewage and Analogous Liquids."

(3) bearing date the 19th November 1914 and numbered 22737 of 1914 for the invention of "Improvements in and connected with the Purification of Sewage and Analogous Liquids."

Notice is Hereby Given that on the 22nd July 1930 an Originating Summons (1929 J. No. 867) issued out of the High Court of Justice (Chancery Division) on behalf of Ernest Reginald Jones, John Donaldson Harward, Percy Alexander Sandford (the personal representatives of Walter Jones deceased) Jones and Attwood Limited and Activated Sludge Limited asking that the TERMS of the above mentioned LETTERS PATENT may respectively be EXTENDED for FIVE YEARS will come before Mr. Justice Luxmoore for directions as to the hearing and any person desirous of being heard in opposition must at least seven days before that date lodge notice of opposition (giving an address for service within the United Kingdom) at Room No. 175 Royal Courts of Justice, Strand, London, and serve a copy thereof upon the undermentioned Solicitors and upon the Solicitor to the Board of Trade.

Dated this 17th day of June 1930.

BRISTOWS COOKE and CARPMAEL,
1, Copthall-buildings, London, E.C. 2,
Upon whom all documents requiring service should be served. 5250

Administrative County of LONDON.

The London County Council invites TENDERS for the SUPPLY and DELIVERY of 3 NEW WASHING MACHINES at the High Wood Hospital for Children, Brentwood, Essex.

The specification, form of Tender, &c., may be obtained on application to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1, upon payment of £1 by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 3A, No. 3 Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 30th June, 1930, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
5235 Clerk of the London County Council.

County Borough of Brighton.
WATERWORKS DEPARTMENT.
EXTENSION OF HEADINGS, &c.

The Corporation invite TENDERS from experienced contractors for EXTENDING the HEADINGS and SINKING BORE-HOLES at their Mile Oak Pumping Station, Portslade, Sussex.

Drawings may be seen and copies of the general conditions of contract, specification and form of Tender may be obtained from Mr. A. B. Cathcart, M. Inst. C.E., M.I. Mech. E., Waterworks Engineer, 12, Bond-street, Brighton, upon payment of a deposit of One Guinea, which will be refunded upon receipt of a bona fide Tender and the return of all documents.

Sealed Tenders, endorsed "Tender for Heading Driving, Mile Oak Works," must be delivered to the undersigned at the Town Hall, Brighton, not later than Twelve Noon on Thursday, July 3rd, 1930.

JAS. H. ROTHWELL,
Town Hall, Brighton, Town Clerk.
June, 1930. 5196

PUBLIC NOTICES (continued) Page 2.
SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Pages 2 and 4.
AUCTIONS, Pages 4 and 100.
PARTNERSHIPS, Page 4.
MISCELLANEOUS, Page 4.
EDUCATIONAL, Page 4.
BUSINESSES and PREMISES (For Sale, etc.), Page 4.
MACHINERY, &c., WANTED, Page 4.
PATENTS, Page 4.
FOR SALE, Pages 4 and 8.
AGENCIES, Page 4.
WORK WANTED, Page 4.
FOR HIRE, Page 100.

For Advertisement Rates see Leader Page.

PUBLIC NOTICES

Broadstairs and St. Peter's

URBAN DISTRICT COUNCIL.
WATERWORKS.
COVERED SERVICE RESERVOIR.

The Council are prepared to receive TENDERS for the CONSTRUCTION of a REINFORCED CONCRETE COVERED SERVICE RESERVOIR, of a capacity of about one million gallons, at the Rumfields Pumping Station, St. Peter's, in accordance with the specification and drawings prepared by their Consulting Engineers, Messrs. Rofe and Raffety, MM. Inst. C.E., 208, Abbey House, Victoria-street, Westminster.

The drawings may be seen and a copy of the specification and form of Tender, with schedule of quantities, may be obtained at the offices of the Consulting Engineers upon the payment of the sum of Five Guineas (by cheque only), which will be returned, subject to the receipt of a bona fide Tender, not subsequently withdrawn, after the Council's decision on the Tenders.

The site may be inspected by arrangement with the Engineer and Surveyor to the Council at the address below.

Tenders to be sent to the undersigned on or before Twelve o'clock Noon on Wednesday, 2nd July, 1930, endorsed "Tender for Reservoir."

The Contractor will be required to conform to the conditions laid down by the Unemployment Grants Committee.

The Council do not bind themselves to accept the lowest or any Tender.

E. F. OWEN,
Clerk to the Council.

Pierremont Hall,
Broadstairs,
17th June, 1930. 5217

Egyptian Government.

ASYUT BARRAGE

The Egyptian Government intends shortly to INVITE TENDERS for the REMODELLING of the ASYUT BARRAGE across the Nile in Upper Egypt.

The works will comprise the building of about 200,000 cubic metres of masonry, mainly in the form of additions to and extensions of the sub-structure of the Barrage. An additional lock will also be built and new sluice and lock gates will be erected to replace those now existing. Tenderers may quote for either or both the masonry and the ironwork of these works.

The Government will reserve the right to accept or reject any Tender; and it may accept or reject either the masonry or the ironwork part of the Tender if both are tendered for together.

The drawings, contract and specification are now being drawn up and can be inspected towards the end of June at the Reservoirs Department of the Public Works Ministry, Cairo, Egypt, and at the office of the Consulting Engineers, Sir Murdoch MacDonald and Partners, 72, Victoria-street, London, S.W. 1. The exact date will be advertised later.

In order to obtain two (2) sets of the contract documents, tenderers must make a deposit of £E5000 and a payment of £E50. The deposit and payment must be made to the Ministry of Public Works, Cairo, direct, or through the National Bank of Egypt in Cairo or Alexandria; in London the deposit and payment must be made at the National Bank of Egypt, 6 and 7, King William-street, London, E.C. 4, to the account of the Egyptian Government. The deposit of £E5000 will subsequently be refunded. The sum of £E50 will be kept by the Government and not refunded to the tenderer.

THIS NOTICE IS GIVEN TO ENABLE THOSE WHO DESIRE TO PARTICIPATE IN THE ADJUDICATION TO MAKE EARLY ARRANGEMENTS FOR VISITING THE SITE WHILE THE RIVER IS IN ITS NORMAL SUMMER CONDITION AND BEFORE IT BEGINS TO RISE TOWARDS THE END OF JULY.

A visit to the site before tendering by a competent engineer representing the tenderers will be one of the stipulations precedent to the acceptance of a Tender. 5219

Manchester Corporation.

"The Rivers Committee invite TENDERS for the CONSTRUCTION of NEW AIR DIFFUSION, "SIMPLEX" and BIO-AERATION UNITS (DAVY-HULME SEWAGE WORKS EXTENSION, WORK No. 3).

Plans may be seen and specifications, bills of quantities and forms of Tender obtained on or after Monday, 16th June, 1930, on application at the City Engineer's Office, Town Hall, Manchester, on payment to the City Treasurer of £10 10s., which sum will, after the Corporation have come to a decision upon the Tenders received, but not before, be returned to the persons submitting bona fide Tenders.

All cheques or money orders are to be made payable to the order of "The Corporation of Manchester."

Tenders, enclosed in the official envelope and addressed to the "Chairman of the Rivers Committee," are to be delivered at the City Engineer's office not later than 9.30 a.m. on Wednesday, the 16th day of July, 1930.

The Corporation do not bind themselves to accept the lowest or any Tender.

F. E. WARBRECK HOWELL,
Town Clerk.

Town Hall, Manchester,
5th June, 1930. 5180

Southport and District Water Board.

TENDERS FOR CAST IRON PIPES AND SPECIALS.

The Water Board invite TENDERS for the SUPPLY and DELIVERY of about 975 Tons of CAST IRON SPIGOT and SOCKET PIPES and SPECIALS, 18in. in diameter.

Specification and conditions of contract may be obtained by competent manufacturers upon application to the undersigned, to whom sealed Tenders, endorsed "Tender for 18in. Pipes," are to be delivered before 10 a.m. on June 27th, 1930.

The Water Board do not bind themselves to accept the lowest or any Tender.

C. BURTON EDE, M. Inst. C.E.,
Engineer and Manager.

14, Portland-street,
Southport,
June 14th, 1930. 5228

Southport and District Water Board.

TENDERS FOR LAYING 18in. WATER MAIN.

The Water Board invite TENDERS from competent Public Works Contractors for LAYING about 4540 Yards of 18in. WATER MAIN, from their Bickerstaffe Pumping Station to near Aughton Park Railway Station, in the parish of Aughton.

The successful contractor will be required to comply with the terms and conditions imposed by the Unemployment Grants Committee and to actively commence work by the 14th July, 1930.

Drawings may be seen at and specification, conditions of contract and bill of quantities obtained from the office of the undersigned upon the deposit of a cheque (only) for £2, made payable to the Board, which cheque will be returned upon the receipt of a bona fide Tender and return of all documents.

Sealed Tenders, endorsed "Tender for Laying 18in. Main," are to be delivered to the undersigned before 10 a.m. on the 4th July, 1930.

The Board do not bind themselves to accept the lowest or any Tender.

C. BURTON EDE, M. Inst. C.E.,
Engineer and Manager.

14, Portland-street,
Southport,
14th June, 1930. 5229

LEASE OF IMPOSING OFFICES FOR SALE.
33, NORFOLK STREET, STRAND, W.C. 2.

In consequence of the recent amalgamation of "THE ENGINEER" LTD., proprietors of "The Engineer," with MORGAN BROS. (PUBLISHERS) LTD., proprietors of "The Ironmonger" and "The Chemist & Druggist," the offices of the three journals have now been transferred to new and more commodious freehold premises which have been acquired at 28-31, Essex Street, Strand, W.C. 2.

The remainder of the lease, covering a further twenty-five years, of the present offices of "The Engineer" at 33, Norfolk Street, Strand, W.C. 2, is in consequence for sale. This particularly well lighted five-storey building has an area of 8,200 sq. ft., and occupies a site at the corner of Norfolk and Howard Streets, adjacent to the Temple Station, whence Westminster and the City may be reached in a few minutes. The building is of modern construction and has a fine and distinctive elevation. It is in good order throughout, and vacant possession can now be had. Rent £1,600. Moderate price. For further particulars apply to:—

WHATLEY, HILL & CO.,
24, Ryder Street, St. James', S.W. 1.

LEASE OF IMPORTANT CITY OFFICES FOR SALE.
42, CANNON STREET, E.C. 4.

In consequence of the recent amalgamation of Messrs. MORGAN BROTHERS (PUBLISHERS) LTD., proprietors of "THE IRONMONGER" and "THE CHEMIST AND DRUGGIST," with THE ENGINEER, LTD., proprietors of "THE ENGINEER," the offices of the three journals have been moved to new and more commodious freehold premises which have been acquired at 28-31, Essex-street, Strand, W.C. 2.
The lease of the entire premises, of which the four well-lighted upper floors have been in occupation of Morgan Brothers (Publishers) Ltd., the Ground Floor and Basement being sub-let to the Aerated Bread Co., Ltd., is in consequence for sale.
Alternatively, the four upper floors (which have also an entrance to Garlick Hill), having a total area of about 7,000 sq. ft. would be let.
The premises are in good order and vacant possession can now be had. Rent £2,000 per annum, inclusive of rates.

For further particulars apply to:
Messrs. FAREBROTHER, ELLIS & CO., 29, Fleet Street, E.C. 4,
or to
HENRY BUTCHER & CO., 63 & 64, Chancery Lane, London, W.C. 2.

PUBLIC NOTICES

Isle of Man Harbours.

TO CRANE MAKERS.

The Isle of Man Harbour Commissioners are prepared to receive TENDERS for the SUPPLY and ERECTION, complete at Douglas, Isle of Man, of the following:—

ONE Hercules Type BLOCK-SETTING CRANE, working load 15 tons, max. radius 67ft.
ONE Goliath Type CRANE, span approximately 60ft., working load 15 tons.

The Isle of Man Harbour Commissioners do not bind themselves to accept the lowest or any Tender.

Further particulars, if desired, may be obtained from Mr. W. H. Blaker, M.I.C.E., Engineer's Office, Isle of Man Harbour Commissioners, Douglas.

A. W. TONGUE,
Secretary.

Harbour Commissioners' Office,
Douglas,
12th June, 1930. 5216

City of Sheffield.

WATER DEPARTMENT.
APPOINTMENT OF GENERAL MANAGER AND ENGINEER.

The Sheffield City Council invite APPLICATIONS for the APPOINTMENT of GENERAL MANAGER and ENGINEER of the Water Department. Experience of Gravitation Works is essential.

The commencing salary offered is £1500 per annum.

The person appointed will be required to pass a medical examination, to contribute to the Council's Superannuation Fund, and to devote the whole of his time to the service of the Council. The appointment will be subject to three calendar months' notice on either side.

Applications to be made on forms, which may be obtained from me, must be addressed to me in a envelope endorsed "General Manager and Engineer, Water Department," and delivered at my office not later than Monday, 7th July, 1930.

Canvassing is prohibited, and will be held to be a disqualification.

WILLIAM E. HART,
Town Clerk.

Town Hall,
Sheffield,
16th June, 1930 5232

Devon County Council.

(NORTHERN AND WESTERN DIVISIONS MAIN ROADS RECONSTRUCTION.)

APPLICATIONS are INVITED for the POST of TEMPORARY ASSISTANT ENGINEER.

Salary at the rate of £300 to £350 per annum, according to experience, together with travelling allowance in accordance with the Council's mileage scale whilst on duty.

Applicants must have had good civil engineering experience after pupilage, preferably on road, railway or bridge construction.

Applications, on the official form, with copies of three testimonials of recent date, must reach the undersigned not later than Monday, 30th instant.

R. M. STONE,
County Surveyor.

9a, High-street, Barnstaple,
June 17th, 1930. 5242

Higham Ferrers and Rushden

WATER BOARD.

WANTED, ASSISTANT ENGINEER for Sywell Works. Good knowledge of Pumping Machinery essential. Wages 55s. per week and house.—Apply in writing only not later than the 26th June, giving age, experience and enclosing copies of two testimonials, to—

J. W. LLOYD,
Engineer.

Council Buildings,
Rushden. 5246

PUBLIC NOTICES

Egyptian Government.

APPOINTMENT OF AN ELECTRICAL ENGINEER.

APPLICATIONS are INVITED for APPOINTMENT as ELECTRICAL ENGINEER in the Ministry of Public Works, Cairo, for work with the Egyptian Irrigation Service in the Sudan.

Applicants must be of British nationality, between 30 and 35 years of age, preferably unmarried, and possess the following qualifications:—

Must have Power Stations, General Workshops, and Marine Experience, and must produce Certificates of satisfactory service, preferably where native labour was employed.

Salary £E24 per month, plus 40 per cent. Sudan allowance (£E1 equals £1 0s. 6d. approximately), free of Egyptian Income Tax.

Pay begins on day of reporting for duty in Cairo.

Sudan allowance begins on arrival in the Sudan.

Free furnished quarters outside Khartoum provided.

The appointment is subject to medical examination.

The selected candidate will be granted actual expenses of steamer and railway journey to Egypt, plus £E10, provided total does not exceed £E40, and similarly on return from Egypt.

Initial period of contract, 2 years, subject to renewal.

Third-class fares and reasonable out-of-pocket expenses will be paid to applicants who are requested to attend for interview and/or medical examination.

Application and specimen contract forms may be obtained from the CHIEF INSPECTING ENGINEER, Egyptian Government, 41, Tothill-street, Westminster, London, S.W. 1., to whom they should be returned with full particulars as to education, qualifications, previous experience, personal references, and COPIES of certificates or testimonials.

Envelopes to be inscribed "ELECTRICAL ENGINEER." 5215

Indian Research Fund Association.

(MALARIAL ENGINEER).

WANTED, for Service with the Malaria Survey of India, Kasauli, a fully qualified and competent CIVIL ENGINEER, with practical experience of Drainage and other problems connected with the Prevention of Malaria.

Appointment will be made on basis of three-yearly contracts, subject to one year's probation. Salary Rs. 1300/- per mensem, rising by Rs. 100 annual increment to Rs. 1500/- in last year of contract (equivalent at present rate of exchange to about £1170-£1350 per annum), with usual departmental travelling allowance and halting allowance; salary to start from date of landing in India. Free passages out and home, 1st Class "B" Peninsular and Oriental, or equivalent, at termination of contract or period of employment; return passage also paid if first year's probation not satisfactory. Usual service conditions regarding leave, i.e., one month's leave with full pay after eleven month's service or equivalent proportion, cumulative; with usual casual leave not exceeding fifteen days in the year.

An suitable candidate would have every prospect of renewing agreement.

Apply, stating qualifications and experience, with copies of relevant testimonials, to the SECRETARY, INDIAN RESEARCH FUND ASSOCIATION, Simla, India, from whom any further information as to qualifications most desired or on any other points can be obtained. The applications should reach the Secretary, Indian Research Fund Association, Simla, by the 15th August, 1930, at the latest. 5220

SITUATIONS OPEN

WANTED, an ENGINEER for Tramways Permanent Way Department. Give full details of training and experience and state age and salary expected.—Address, P7158, The Engineer Office. P7158 A

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED for Engineering Works in Glasgow, experienced Engineer with knowledge of Sugar Machinery and capable of investing a few thousand pounds. Able to take complete control of commercial as well as engineering side of business. State qualifications, age and remuneration required.—Address, "ENGINEERING," Wm. Porteous and Co., Glasgow. P7151 A

ASSISTANT ENGINEER, to Specialise on Investigation and Development of Manufacturing Methods and General Factory Efficiency. Applicants will be required to give evidence of sound engineering training and sufficient previous experience. Critical and constructive faculties above the average are essential.—Apply, HENRY HOPE and SONS, Ltd., Smethwick, Birmingham. 5222 A

BRAZIL.—REQUIRED for Sao Paulo, FIRST-CLASS MAN, to Take Charge under Works Manager of complete Wiredrawing Plant for Copper, Brass, &c. Only those with full experience in all branches of wiredrawing need apply. Experience in Rolling Mill Work desirable, but not essential. Must be able to get output and handle men. General terms to the right man.—Write, in confidence, stating age, contract term, salary, married or single, and fullest particulars of experience, to Box 288, Sells Advertising Offices, Fleet-street, E.C. 4. 5239 A

CIVIL ENGINEERING ASSISTANT REQUIRED for Contractors' Drawing-office; preference to University Graduate having had outdoor experience on contractors' staff.—Applicants please state age, experience, and expected salary, to A. JACKAMAN and SON, Ltd., Slough. P7161 A

HIGH-CLASS ENGINEERING SALESMAN of proved ability REQUIRED, to take over exclusive sales territory Industrial North. Experience in use of Heat Economy Instruments and associated Plant desirable. Preference shown to applicants with good practical boiler experience.—Address, stating age, earnings desired, date free, and full particulars, 5148, The Engineer Office. 5148 A

INDUSTRIAL ENGINEER, Age 28-35. Sound technical education necessary; University Engineering Degree preferred. Four to five years' practical shop experience essential. Position offers attractive financial future. Post in Great Britain. Candidates in replying should state age, present salary, and general qualifications.—Address, P7137, The Engineer Office. P7137 A

INSPECTOR and RATE FIXER in Electro-plating Establishment WANTED.
Thoroughly experienced in piecework rates for polishing and plating.
Address, stating experience and salary required, P7150, The Engineer Office. P7150 A

MACHINE SHOP MANAGER REQUIRED for Firm in Sheffield district; must have experience in Jig Design and Production Layout and must be an expert on Internal and External Grinding; management experience essential. State age, experience, and salary.—Address, 5233, The Engineer Office. 5233 A

REINFORCED CONCRETE DESIGNER REQUIRED (Temporary) for London Consulting Engineer's Office. Must be conversant with L.C.C. requirements. State experience and salary expected.—Address, P7143, The Engineer Office. P7143 A

SALES ENGINEER REQUIRED, Age 21 to 25. Sound technical training, preferably in Steam Engineering. Previous selling experience not essential.—Address, 5226, The Engineer Office. 5226 A

WORKS SUPERVISOR REQUIRED for Electro-plating Establishment in London. Technical and practical knowledge necessary.—Address fully, stating experience and qualifications, and salary required, P7149, The Engineer Office. P7149 A

DRAUGHTSMAN, London, General Engineering and Works Layout experience. Preference given to man also having marine experience. State age, qualifications and salary required.—Address, P7155, The Engineer Office. P7155 A

DRAUGHTSMAN REQUIRED for Civil Engineer's office in Westminster. Must be good Tracer and used to Civil Engineering and Reinforced Concrete work.—Address, giving age, experience, and salary required and enclosing sample of work (returnable), P7156, The Engineer Office. P7156 A

DRAUGHTSMAN REQUIRED IMMEDIATELY, young man with good experience of mass production of Instruments, Clock Mechanisms, &c. Must fully understand modern workshop methods and be able to produce accurate working drawings quickly and with little supervision.—State age, experience, salary expected, and when free to VENNER TIME SWITCHES, Ltd., 45, Horseferry-road, S.W. 1. P7152 A

DRAUGHTSMAN WANTED, with Experience of Heavy Oil Engines. Must have good technical knowledge.—Apply, stating experience, age, and salary required, to CHIEF ENGINEER, Tangyes Limited, Cornwall Works, Birmingham. 5249 A

GOOD ENGINEERING DRAUGHTSMAN REQUIRED by old-established Reinforced Concrete Engineers. Good experience in Concrete or Steel Work design essential. State age, experience, and salary required.
Address, P7142, The Engineer Office. P7142 A

JUNIOR DRAUGHTSMAN WANTED; Used to Detail Work, preferably with Diesel Oil Engines. State age, experience, salary required, and when available.—Address, 5252, The Engineer Office. 5252 A

SITUATIONS WANTED

ENGINEER, 1st Class B.O.T. Cert., Keen and resourceful, age 28, experienced in steam and oil engines and electricity, REQUIRES POSITION at home or abroad.
Address,
P7118, The Engineer Office. P7118 B

ENGINEER (32), First Class Board of Trade Certificate and Bachelor of Engineering Degree (Liverpool), DESIRES POSITION ashore.—Address, P7147, The Engineer Office. P7147 B

ENGINEER (31) SEEKS CHANGE; Public School education, exp. shops, D.O., asst. engr., works erection, extensions and maintenance, iron and steel works and rubber factory.—BM/L 024, London, W.C.1. P7145 B

MARINE ENGINEER, Sailed as Chief for Eleven years, eight with large motor vessels, DESIRES SHORE EMPLOYMENT as Superintendent, Works Maintenance or Construction. Experience with British and Continental types of heavy oil and semi-Diesel engines. Wide experience of auxiliary machinery and plant.—Address, P7139, The Engineer Office. P7139 B

POSITION REQUIRED by First-class Certificated Mechanical Engineer with 20 years' experience, Inspection ordnance engines and various components, organising and control.—Box 843, c/o C. Mitchell and Co., 1, Snow-hill, E.C. 1. P7144 B

TEMPORARY POSITION, July/Sept., SOUGHT by Undergraduate, experienced mechanical engineering, plant layout, &c.—Address, P7122, The Engineer Office. P7122 B

DRAUGHTSMAN, Experienced in Steam and I.C. engines, jigs and press tools, pipe and tank work, and general engineering and electrical work, DESIRES POSITION with Firm of Mechanical or Electrical Engineers in London district.—C. W. CASTLETON, 76, Lee-road, Aldeburgh, Suffolk. P7157 B

For continuation of Small Advertisements see page 4.

Spencer-Bonecourt Patent Waste Heat Boilers.
Broadway Bldgs., Broadway, Westminster, S.W.1.

A Seven-Day Journal

Railway Centenaries.

ALL the continental countries which owe so much to their railways have decided to celebrate their respective centenaries from 1935 onwards. As the celebrations are to be held all over Europe, it is felt that some central organisation is necessary in order to ensure that they are carried out in a manner suitable to the occasion, while mutual assistance amongst the different countries will give more historical interest and importance to the proceedings. Therefore, the Association of Railway Centenaries, which was formed in Paris some time ago to co-ordinate the celebrations, is already preparing the French arrangements for 1937, when, amongst other ceremonies, a statue will be unveiled in Paris to the memory of Marc Séguin. Meanwhile the Comité des Chemins de Fer and the commercial travellers' associations have decided that they will not wait until 1937, but will carry out a ceremony on their own account, and the State Railways have consented to run a train with an 1837 locomotive from Paris to Saint-Germain on July 6th next. The passengers will be received by the Municipal Council of Saint-Germain and festivities will be arranged in their honour. The locomotive, which was built by Buddicom, weighs 18 tons, and, when in service, was capable of hauling a load of 80 tons at a speed of 28 miles an hour.

The Birth of British Broadcasting.

SUNDAY, June 15th, was a historic day in the development of broadcasting, for on that date ten years ago Dame Melba broadcast her memorable concert from the Marconi Company's experimental station at Chelmsford. The occasion was the first on which an artist of international reputation had sung before the microphone, and was virtually the birth of entertainment broadcasting in Great Britain. Before the broadcast by Dame Melba, the programmes transmitted from the station at Chelmsford had been organised mainly for the purpose of technical experiments in connection with the development of wireless telephony, but the potential value of the new system had not been overlooked and concerts had been organised with the assistance of local amateurs. The number of listeners to the first Chelmsford concerts was, however, small; in fact, apart from operators on ships, some of whom received the programmes at distances of more than 1000 miles, not more than three or four hundred experimenters possessed the necessary receiving apparatus. The first wireless telephone transmitter at Chelmsford was installed in the Marconi works in 1919, and had a power of 6 kilowatts. A little later a more powerful transmitter of 15 kilowatts was built on the same site, and in February and May, 1920, two daily programmes consisting of news and vocal and instrumental music were radiated and heard in a large number of places in Great Britain and abroad. Following the public interest aroused by Dame Melba's concert the Marconi experimental station at Writtle was established in 1921. The first 2LO station established at Marconi House, London, was put into operation early in 1922, as a supplementary station to Writtle. In the meantime various parties interested in the establishment of a broadcasting service had entered into negotiations with the Post Office, and the outcome was the formation of the British Broadcasting Company—now the British Broadcasting Corporation—which started regular transmission from the station at Marconi House on November 14th, 1922. The number of listeners was then about 20,000, compared with 3,117,000 registered on April 30th of this year.

The Late Mr. E. A. Sperry.

IT is with great regret that we have to record the death on Monday, June 16th, of Mr. Elmer Ambrose Sperry. With Mr. Sperry's achievements as an engineer and inventor our readers are familiar. He was born at Cortland, New York, in October, 1860. On leaving Cornell University at the age of twenty, he at once turned his inventive and commercial abilities to account by founding the Sperry Electric Company of Chicago, and manufacturing an improved and very successful design of arc lamp. In 1883 he erected the highest electric beacon in the world, one of 350ft., on Lake Michigan. Five years later he invented an electric chain undercutting coal-mining machine. Next he turned his attention to the electric propulsion of tramway cars. He founded the Sperry Electric Railway Company of Cleveland as an outcome. This company in 1894 was bought by the General Electric Company of New York. His inventive ability then took him into other fields, and among the subjects which engaged his interest round about this period were the internal combustion engine, the chlorine de-tinning process, and an electrolytic process for producing white lead from impure by-product lead. In 1915 he devised a new form of high-intensity searchlight which has been widely adopted for naval, military, and aeronautical purposes. Incidentally, it was also employed by Professor A. A. Michelson as the source of illumination in his recent repetition of the famous Michelson-Morley experiment on the velocity of light. Dr. Michelson also required for that experiment an eight-sided mirror revolving at 50,000 revolutions per minute. Mr. Sperry was quite accustomed to such speeds in the production of gyroscopic compasses, and was enabled to provide Dr. Michelson with his requirements. In recent years Mr. Sperry invented an electrical method for detecting flaws in rails, an account of which was published in our issue of May 10th, 1929. It will be seen from this summary of some of his activities that his inventiveness was by no means confined to applications of the gyroscope, the device with which his name will probably always be principally associated.

Mr. Sperry and the Gyroscope.

WE notice in several obituary notices of Mr. Sperry that he is described as the inventor of the gyroscopic compass. We are not aware that he ever claimed that distinction in unqualified terms. Mr. Sperry's first gyroscopic compass was installed in the United States battleship "Delaware" in 1911, but in 1910 the Anschütz brothers were producing a well-developed, if imperfect, form of the device. Mr. Sperry undoubtedly deserves the honour of having devised an original type of gyroscopic compass and of having added to it equipment for recording the ship's course, for steering her automatically and so forth. If, however, anyone is to be credited with "the" invention of the gyroscopic compass, it should be Foucault, who in 1855 demonstrated or sought to demonstrate the rotation of the earth by means of a gyroscope. Mr. Sperry brilliantly applied gyroscopic principles, not only in compasses, but for the stabilisation of ships and aeroplanes. His system of ship stabilisation was described in our issue of June 6th. It may with justice be said to be the only system of gyroscopic stabilisation for ships which so far has been developed beyond the experimental stage. Among recent gyroscopic applications introduced by Mr. Sperry's company we may mention the Sperry gyro direction indicator for aeroplanes and the Sperry artificial horizon. The second-named device consists of a gyroscopically mounted wheel driven by a small Venturi tube, and is combined with an indicator which shows the pilot of an aeroplane whether he is diving or climbing, and whether he is flying level or with one of his wings low. The instrument has already proved its value, both to pupil fliers and to skilled pilots flying through clouds or in other conditions in which the natural horizon is obscured.

Wireless Telephony at Sea.

WITHIN the next few years it is probable that passengers on any of the principal liners will be in a position to ring up any telephone subscriber in practically any country in the world, while the ship is steaming on any of the Seven Seas. The remarkable quality of the telephone service already available with the latest Marconi equipment was recently demonstrated to many thousands of wireless listeners in the British Isles when a conversation between a passenger on the White Star liner "Homeric" in mid-Atlantic and Mr. Harold Nicolson in the studio at Savoy-hill, London, was broadcast by the British Broadcasting Corporation. Every word of the "Homeric" passenger's remarks was as clearly heard as the questions and comments of Mr. Nicolson speaking into the microphone in London. The telephone equipment on the "Homeric" is identical in its main features with the apparatus used by the Marchese Marconi on his yacht "Elettra," with which he has spoken from the Mediterranean to Sydney, London, Bombay, Montreal, New York, Buenos Aires and Rio de Janeiro. As demonstrated by the Marchese Marconi, this installation is capable of covering a world-wide range, and experts who have heard conversations carried on by its means are said to have been amazed at the clarity and steadiness achieved. While great interest centres on the use of telephony on such ships as the "Homeric," telephony at sea is not likely to be restricted to large passenger vessels. It is, in fact, already widely used on small vessels on which no skilled operator is carried, the Marconi Company having designed and constructed self-contained transmitting and receiving equipments which require no more experienced manipulation than the ordinary domestic telephone.

Sheffield Steel.

AN important circular letter has been sent to all British consular officers throughout the world in the joint names of the Master Cutler, Mr. A. K. Wilson, and the President of the Sheffield Chamber of Commerce, Mr. R. W. Matthews. The object of the letter is to correct systematic misstatements concerning Sheffield and her steel industry, which for some years past interested parties have been circulating, particularly in countries outside the British Empire. The letter deals vigorously with four specific statements which malign Sheffield's position and prestige. It has been asserted that Sheffield at the present time is not working to full capacity and that her trade is consequently on the down grade. The letter states that Sheffield to-day is actually turning out annually 50 per cent. more steel and steel products than she did in the best of her pre-war years. She is not working to her present full capacity only because during the war her capacity was trebled. Secondly, it has been asserted that unemployment in Sheffield is unusually high and that that fact is a sign of decadence. The letter states that at the end of the war the city was left with an exceptionally large number of unemployed war workers. She has now absorbed into her factories working under peace conditions 75 per cent. of these unemployed workers, in spite of the fact that she has lost almost entirely one of her pre-war staple industries, heavy and other armament work. In the third place, it is alleged that the steel outputs of Sheffield's foreign competitors have gone ahead more rapidly than her own. On a mere tonnage basis that statement is true. The extra tonnage of foreign steel is, however, accounted for by immense quantities of cheap inferior steels which are not made at Sheffield. The comparison is therefore completely misleading. Finally, it is asserted that the quality of Sheffield steels has deteriorated. The letter claims that Sheffield steels to-day are vastly better than they ever were and are much further ahead of the rest of the world's steels than at any previous time. In support of that assertion it is pointed out that Sheffield is supplying many special steels to competing steel-producing countries protected by tariffs designed to be prohibitive. United States users, for example, are to-day purchasing certain Sheffield steels at three or four times the price they would have to pay to their own makers for the nearest American-made equivalent.

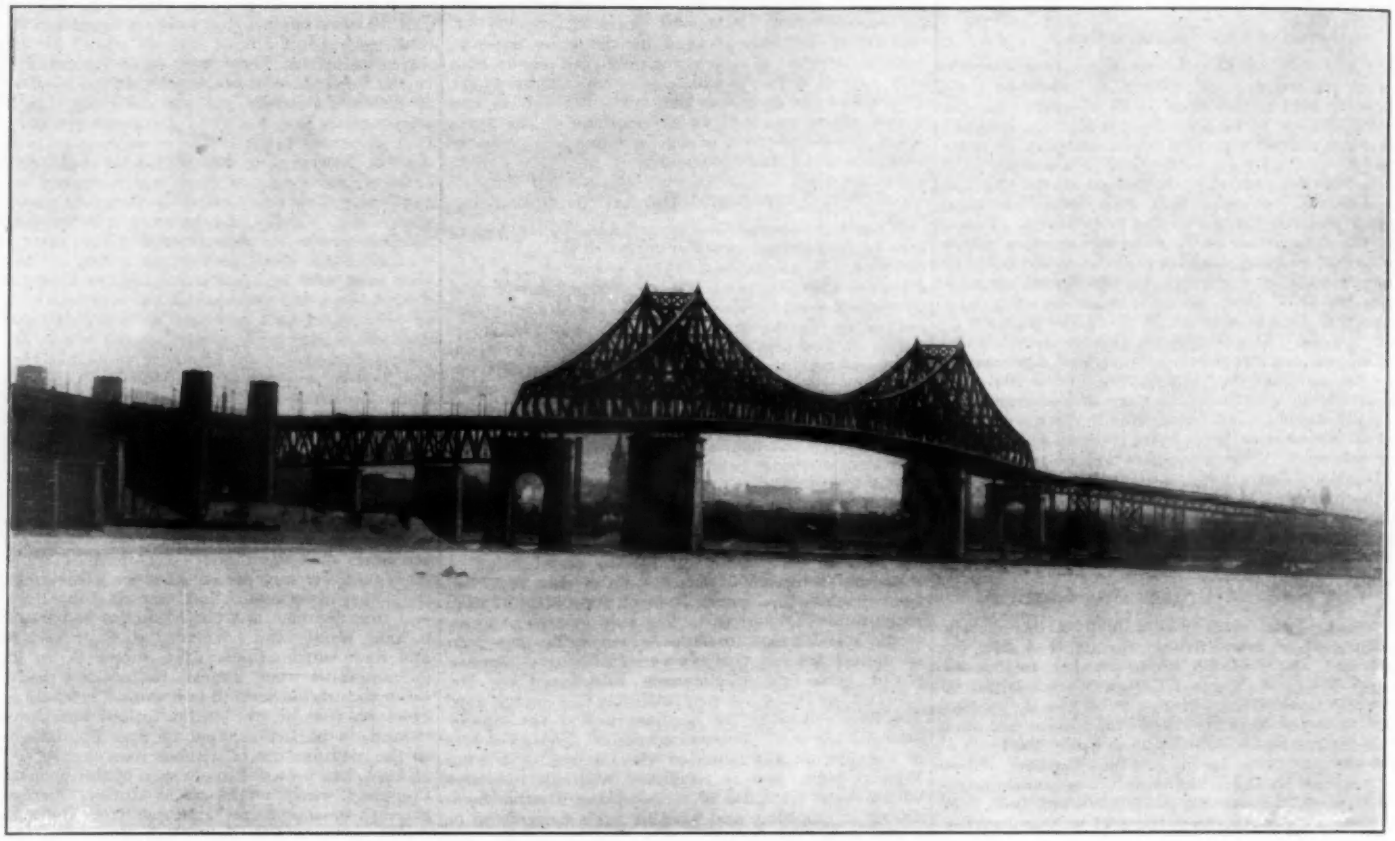
Transferred Miners.

WE recently visited an electrical insulator factory at Stourport, at which the bulk of the labour employed consisted of miners and their families transferred from the distressed areas. It was a pleasure to learn that the experiment had proved fully successful and that the men and their families had been found to take kindly and efficiently to their new labours and new surroundings. The miner is, in general, an adaptable man, almost, in fact, as ready as a sailor to turn his hand to new work. It would appear, however, that he has his limitations like the rest of us and, in particular, that he does not take readily to the manufacture of wireless receiving sets. That, at least, has been the experience of the Aeonic Radio Company, whose works are at Horley, Surrey. The attempt to import and train men from the distressed mining areas was described last Monday at the company's general meeting by the chairman as one of the principal causes of the poor trading results during the past fifteen months. Very few of the miners were able to adapt themselves to the new trade in spite of sympathetic and patient teaching. Those who became efficient in the making of wireless receivers formed a very small minority. As a result large numbers of receivers were despatched in a condition which was not up to the company's standard and were returned by its customers. The position has now been remedied, and it is claimed that every receiver which leaves the factory will to-day bear the closest possible inspection. The company makes a wide range of wireless receivers which are sold by its customers under many names and not only as Aeonic receivers. It also manufactures general electrical equipment, such as high-power switchgear and is developing television, radio gramophones and talking picture apparatus.

The Government and Unemployment.

ON Tuesday a conference was opened at Guildhall between representatives of the Government and local authorities, the object of the conference being to discuss means of co-operation between Government departments and local authorities with a view to expediting the carrying out of unemployment relief schemes. The Prime Minister occupied the chair, and in his opening address emphasised the necessity for careful and full consideration being given to proposed relief schemes. Hastily devised plans might, he said, give employment to some people for a short time, but they might in the end increase rather than reduce unemployment. The Lord Mayor of Sheffield stated that the present scale of Government grants for relief works was inadequate, and that the works already carried out had led local authorities to incur heavy commitments. The burden was already so heavy that they could not on the existing terms proceed with new schemes. Mr. F. H. Barriman, on behalf of the County Councils' Association, said that it would be helpful if local authorities could select their labour from their own localities and not be compelled to employ imported labour. Sir William Ray, of the London County Council, said that for the past six years local authorities had been expediting relief schemes at the request of various Government departments. It was impossible to keep on expediting schemes. For years they had been mortgaging the future and they were now being asked to mortgage it still farther. The L.C.C., he continued, made it a deliberate policy to give a monetary preference to British goods. For a time the preference had been limited to about 15 per cent. To-day there was no limit. Each case was considered on its merits and a preference of as much as 48 per cent. had been given to a British tender. He suggested that the Government should decide that a definite preference should be given to British industry in all national and local expenditure, and that the additional cost involved in placing orders with British firms should be borne in equal proportion between the Government and the local authority involved.

MONTREAL HARBOUR BRIDGE OVER THE ST. LAWRENCE RIVER



GENERAL VIEW FROM THE NORTH BANK

Montreal Harbour Bridge.

No. I.

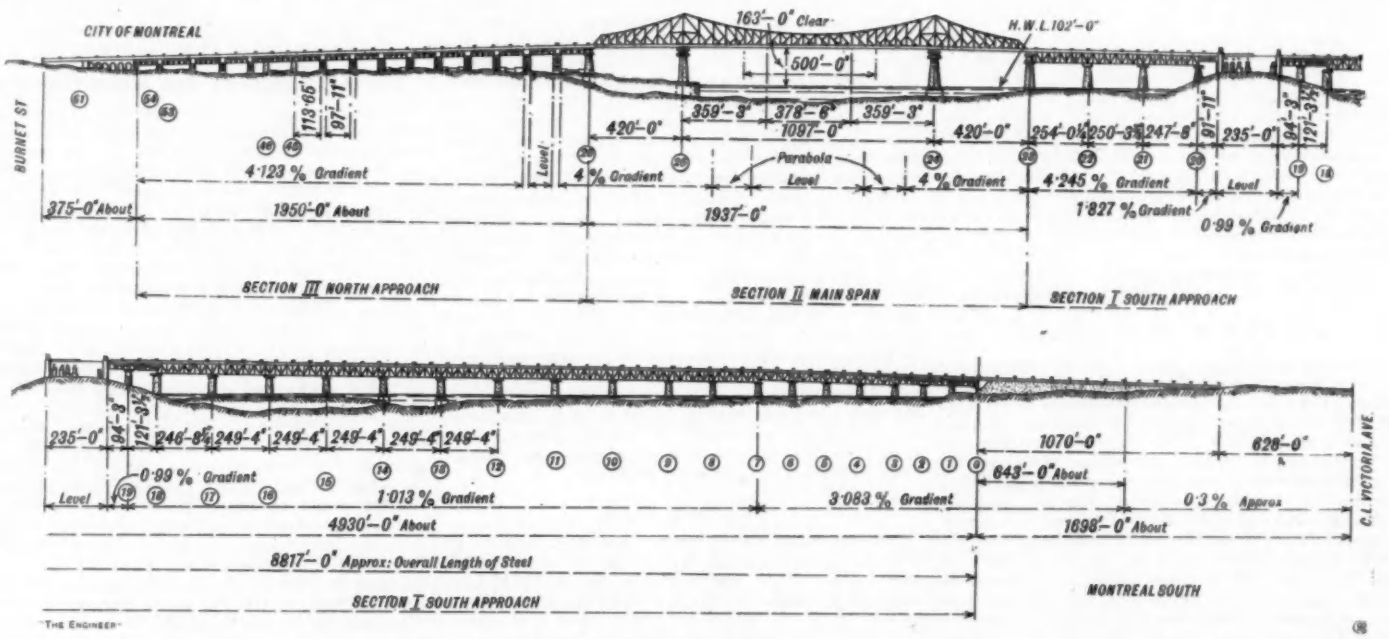
REPRESENTING one of Canada's greatest bridge engineering attainments, the Montreal Harbour Bridge, crossing the St. Lawrence River, has just been completed. The structure, three views of which are given herewith, is almost two miles in length and rises to a height of 155ft. above the high-water level over the ship channel. Erection of steel commenced from the South Shore in September, 1926, and in the following year was being carried on simultaneously at both ends, the final linking up taking place on July 10th, 1929. The steel superstructure was entirely completed by the beginning of October last year, or nearly a year and a-half ahead of time, the contract requiring completion by March 1st, 1931.

In January, 1925, Messrs. Monsarrat and Pratley, consulting engineers, of Montreal, were appointed designing and supervising engineers for the proposed bridge, with J. B. Strauss, of Chicago, as associate. At the same time an advisory board of engineers, representative of the various interests affected, was created to collaborate in the selection of a site and in the preparation of the plans and specifications. Tenders were called in due course, and in October, 1925, the contract for the entire steel superstructure was awarded to the Dominion Bridge Company, Ltd., of Montreal. For convenient reference the structure was subdivided by the engineers into Section 1, south approach; Section 2, main span; and Section 3, north approach. The design drawings for the south approach were practically complete at the time the contract was awarded, thus enabling detail drawings to be proceeded with at once. The design of the main span was, however, in an embryonic condition owing to the lack of time previously for proper investigation, and it was obvious that considerable time would be required to develop the details, estimate the weights and complete the calculations. After a number of changes in the general proportions of the main span had been discussed with the engineers and agreement reached, the contractor undertook to develop fully the design of this section of the superstructure, all calculations and details to be checked by the engineers. At this period the alignment of the north approach was unsettled. Difficulties regarding property expropriations finally led to a radical alteration in the original arrangement, with the result that it was impossible to complete the design of this section until the spring of 1928.

The methods to be employed in the erection were left for the contractor to determine, with the single stipulation that the navigation channel must at all times be kept clear of obstruction to shipping. It was therefore requisite that each half of the channel span be erected by cantilevering to the centre of the span, at which point the final connection would be made.

The bridge is designed to carry highway, tramway and pedestrian traffic only. The floor system was consequently of insufficient strength to permit the use of the derrick cars and locomotive cranes so common on railway bridge erection, and it was necessary to develop special equipment. The safe capacity of the floor system and other practical considerations limited the weight of individual members to about 40 tons.

The dividing line of erection was the centre of the channel span. The superstructure to the south had as its base of operations the south storage yards, where materials were received, unloaded for storage



PROFILE OF THE BRIDGE

and re-handled as required to the bridge over connecting service tracks. It was necessary that erection be commenced at the south abutment and be carried on in sequence to what is known as St. Helen's Island and thence to the main span. The superstructure north of the dividing line had as its base of operations the north storage yard under the north anchor arm. Materials were received here at ground level, hoisted to the floor of the bridge as required, and distributed to their destination. Erection naturally commenced on the anchor arm, the north approach being inaccessible until after completion to the anchor pier.

South Approach and Pavilion.

The south approach extends in a straight line from the south abutment to the pavilion on St. Helen's Island, a distance of approximately 4000ft. Changing alignment at this point, it continues to the south end of the main span, a further 900ft. A ramp 250ft. in length leads from the pavilion to road level on St. Helen's Island. The total length is therefore approximately 4900ft. from the south abutment to the main span, including the ramp. The approach consists principally of a series of deck truss spans carried on masonry and concrete piers, and graduated in length from 122ft. 6in. to 245ft. The floor rises on a 3·083 per cent. gradient for about 1000ft., flattens to 1·013 per cent. to St. Helen's Island, and after a level section over the pavilion rises sharply on a 4·245 per cent. gradient to the end of the main span.

The trusses are of conventional Warren type, are spaced at 40ft. centres and vary in depth with the span. The floor system is carried above the trusses by floor beams which rest on and cantilever over the top chords. The lateral and bracing systems are of liberal proportions. Short skew spans were necessary at each end of the pavilion to suit the arrangement at that point, and the ramp is also somewhat different in design to the main approach. The steel work of the pavilion is of simple design, the floor of the bridge being carried on the roof of the pavilion by means of heavy girder construction. Throughout the main portion of the approach the floor panels are 24ft. 6in. in length; this uniformity proving a great advantage during erection. The steel work of the approach is of special carbon steel, except in the trusses of the 245ft. spans, where silicon steel is used with a limiting thickness of ¾in.

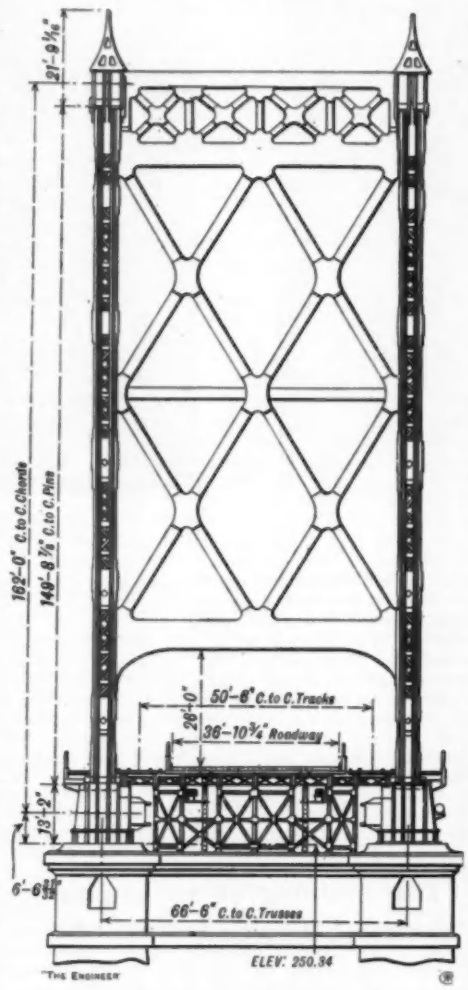
Erection was commenced at the south abutment during September, 1926, and seven spans were completed in that season. Operations were resumed during April, 1927, and the structure was completed during that season to pier 20, one span beyond the pavilion. The remaining spans were erected early in the season of 1928. It had been planned to complete the south approach by the end of 1927, but operations were retarded throughout by the progress on the piers and pavilion substructure, with the result that winter ice conditions made it impracticable to proceed further than the point noted.

The superstructure was erected by means of travellers operating on the deck of the bridge, the materials being delivered alongside on either service track as required. The service tracks being 50ft. 6in. centres, it was necessary to restrict the overall width of the travellers to about 40ft. The changes in the floor gradient had also to be provided for in the traveller construction. The principal erection was carried out by a specially designed traveller—No. 1—the base of which consisted of a steel frame 25ft. wide by 50ft. long, mounted on four four-wheel trucks travelling on two tracks of 4ft. 2in. gauge spaced 25ft. centres. On this base were mounted two steel derricks with masts over the forward trucks and booms 70ft. long, each boom being equipped with main falls of 20 tons capacity and an auxiliary line of 5 tons capacity. The weight of the traveller in full working order was 120 tons. It was designed to permit the safe handling of a weight of 16 tons on either or both booms, at 60ft. forward radius and 40ft. side or rear radius, the capacity increasing at lesser radius to a maximum of 20 tons.

An auxiliary traveller—No. 2—was also provided. Its base was of simple timber construction mounted on special double-flanged truck wheels rolling directly on the flanges of the roadway stringers. On this base were placed two standard stiff-leg derricks, with 70ft. booms of 12 tons capacity, operated from steam hoisting engines. This traveller was used to place the floor steel behind traveller No. 1, to remove the falsework, and to perform other handling operations as required. At a later date, a third traveller was used to place the fences, curbs, lamp poles, and other sundry steelwork of the deck. This traveller consisted of a light "Jinniwink" derrick mounted on a standard flat car and operated from the service tracks.

The method of erecting the various spans for the south approach was partly on timber falsework and partly by cantilevering. The use of falsework throughout this section had serious drawbacks. In the first place, winter ice conditions prohibited falsework in the river from about December 15th until the following May. Secondly, the river bottom between the south shore and St. Helen's Island consists for the most part of irregular shale rock, which entirely precluded the driving of piles. Although the water is very shallow throughout the greater part of the season, the depth is sufficient when coupled with the current to render very laborious the fitting of falsework to a good bearing on the bottom. Thirdly, the changes in gradient and in the depths of the spans resulted in a constantly changing distance from the underside of the steel to the river bottom, necessitating alterations in the height of the falsework at every panel. Fourthly, the very considerable height of steel above river bottom, particularly beyond St. Helen's Island, was unfavourable to the use of falsework on account of the quantity involved and the time required for setting up and dismantling. These various factors led to the decision to erect by cantilevering wherever practicable, as being both more economical and more expeditious. In all, three of the four 147ft. spans and ten of the twelve 245ft. spans were erected in this manner.

Eight of the nine 245ft. spans south of St. Helen's Island and two of the three similar spans north were erected as cantilevers. Special treatment of them was necessary to avoid an excessive amount of erection reinforcement in the chords adjacent to the loaded pier. All overhead harness was specially developed, which increased the effective depth of the trusses at the pier from 35ft. to 70ft., and reduced the reinforcement required to a small addition in the end bottom chord sections. The tension members consisted of medium heat-treated eyebars having a yield point of 50,000 lb., and an ultimate strength of 80,000 lb. per square inch. Silicon steel was used in the posts



CROSS SECTION OF THE BRIDGE

and the 10½in. pins were of forged nickel steel. The necessary top chord sections of the spans were specially bored in the shops, the pin holes being liberally reinforced. Particular attention was given to all details to ensure ease of handling during the successive use of the harness.

North Approach.

At the Montreal end, the approach to the main span consists of a viaduct approximately 2300ft. in length. Of the total length, 1950ft. is of steel construction, and consists of a series of short deck truss spans supported on steel towers, except for masonry piers at the beginning. Erection commenced at the end adjacent to the main span during October, 1928, and was completed in February, 1929. Traffic was diverted by the authorities at the various city streets in turn while construction proceeded overhead. The materials were received in the north storage yard by rail, hoisted to the floor of the bridge, and distributed by flat cars on the service tracks to the point required. These cars were operated by cables leading to steam winches on the deck near the north main pier.

The first span was erected by traveller No. 3, which had been used on the erection of the north anchor arm earlier in the season. The span was supported near its midpoint by a timber tower of similar construction to those used in the south approach falsework. With the traveller standing at this point, it was possible to erect the near bent of the steel tower which was sufficiently rigid to permit the span being blocked thereon. The traveller, having been moved forward, completed the erection of the tower, after which the span was jacked clear of the falsework and landed on the tower. A portion of the next span was then erected, and traveller No. 1, previously used on the south approach, was set up for the erection of the remaining spans.

Main Span.

The main span of the bridge is a symmetrical cantilever having an overall length of 1937ft. The centre span is 1097ft. centre to centre of main piers, which provides a clear navigation channel of 1000ft., the pier on the north wharf being set back about 50ft. from the face of the dock wall. The trusses of the anchor and cantilever arms are of the K design, so successfully introduced in the Quebec Bridge, and are spaced at 66ft. 6in. centres to suit the floor requirements. They are 162ft. in depth at the main piers, reducing to 50ft. at the end of the anchor arm, and to 54ft. at the centre of the span. Special pains were taken to obtain the most pleasing outline consistent with economical proportions, the top chord curvatures being carried through into the suspended span for the sake of appearance. To permit a harmonious treatment of the web members, a varying length of panel was adopted for the main arms, the longer panels being subdivided for the sake of economical construction. A tapering effect was introduced in the top and bottom chords of the main arms, and the bracing at the main posts and end portals was laid out with special regard to appearance.

The specification called for a suspended span, 312ft. in length, as lending itself to ease of erection. In the interest of economy and appearance, however, the contractor suggested and undertook the erection of a longer span, the length finally adopted being 378ft. 6in. The ultimate arrangement of the members of this portion of the span was governed largely by erection considerations. The trusses are in parallel planes throughout and are of riveted construction, with pin connections at points where free articulation is desirable. The truss members consist for the most part of two built-up webs in planes parallel to the axis of the bridge, connected by lacing systems and squared up by transverse diaphragms at intervals. The distance between webs is 42½in. in the anchor and cantilever arms, except in the case of the main post, where it is 47½in., and is 26in. in the suspended span. The gusset plates of the upper and lower connections are built into the top and bottom chords respectively; those at the midpoints into the lower diagonals.

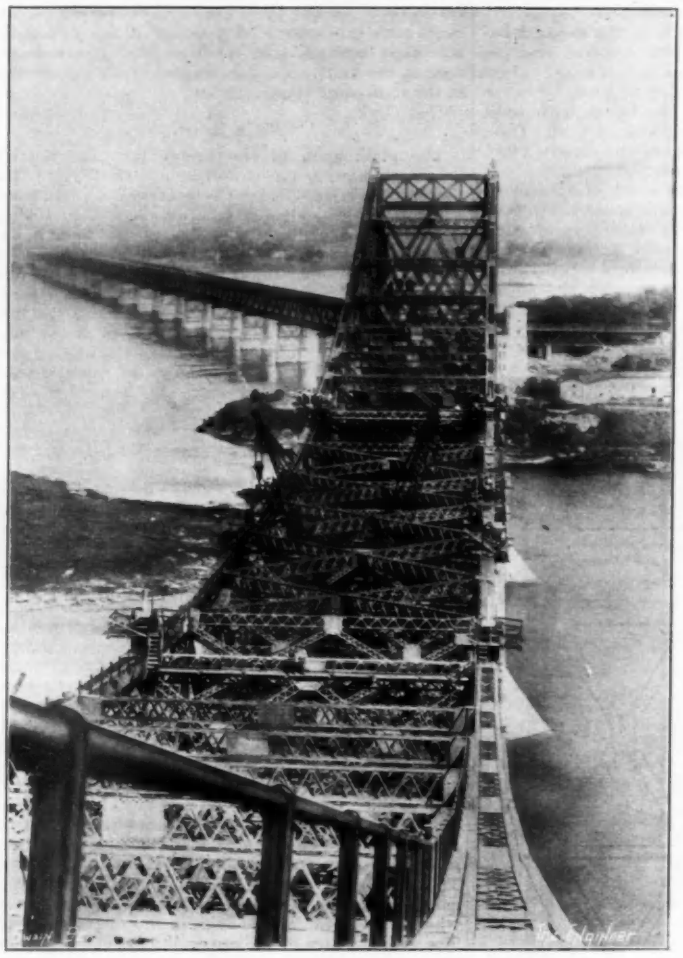
The trusses are supported at the main piers on shoes of special design, consisting in each case of a cast steel base in three sections, on which is mounted a structural member built up of four massive webs with interconnecting diaphragms. The base rests on a bush-hammered surface on the pier concrete, layers of heavy canvas being laid on this surface and coated with red lead just prior to the placing of the castings in position. The base is connected to the pier by anchor bolts, which were set in advance to template, and to the upper shoe section by rivets and turned bolts. All truss members converging on the shoes are pin connected, important advantages being facility of erection and easement of secondary bending stress by rotation on the pins. The bottom chord and shoe connections consist of 20in. diameter pins in split bushings of 30in. external diameter. For the main post, the pins are 24in. and the split bushings 36in. diameter; for the diagonals, the pins are 16in. diameter, no bushings being required. The base castings of the shoes weighed 17 tons each; the upper sections were divided longitudinally in halves for shipment, each unit weighing about 39 tons.

Each main post consists of six sections, which sections are built up of two webs 84in. wide and 47½in. apart, with a continuous middle diaphragm and a plane of lacing on either flange. The upper post sections, which support the links, are provided with wing plates on either side, bored to engage the pins which connect the upper diagonals to the links. The weight of each post section was approximately 40 tons.

In order to avoid heavy secondary bending stresses at the top of the main post during erection and in the completed structure, links similar in principle to those used in the Quebec bridge were provided. Each link is built up of four massive webs with interconnecting diaphragms and is carried on top of the main post on a pin with split bushings of the same size and type as at the base of the post. The converging truss members are pin-connected, the size of the pins being 21in. for the top chords and 13in. for the upper diagonals. The wing plates on the upper post sections provide interlocking connections with the links, which ensure stability under all conditions, any unbalanced loading being readily compensated by the bending resistance of the posts. This construction proved most convenient during erection. The links are surmounted by ornamental finials of simple plate construction with cast iron caps. The links were divided longitudinally in halves for shipment, each unit weighing about 25 tons.

The bottom chords of the anchor and cantilever arms are spliced at all main panel points, and at the mid-panel point where necessary on account of weight.

MONTREAL HARBOUR BRIDGE



MAIN SPAN—CENTRE SECTION

NORTH APPROACH FROM TOP OF MAIN SPAN

The sections are built up of two webs, 42½in. apart, and tapering in depth from 60in. at the shoes to 39in. at the anchor pier and 42in. at the cantilever arm. In the heavier members the webs are connected by continuous coverplates on the top flanges and lacing on the bottom; elsewhere, by lacing on both flanges. The main gusset plates are spliced into the webs, the chord joints being placed in each case at the edge of the gusset plates. All joints are of the butt type, but they are spliced in addition for practically the full value of the material. The different sections varied in weight up to a maximum of about 40 tons.

The top chords are spliced at all main panel points and were also divided longitudinally in halves for shipment where necessary on account of weight. The sections are built up of two webs 42½in. apart and vary in depth from 62in. at the main post to 40in. at the ends of the arms. The depth is constant throughout each panel, but is made to reduce about 3in. in each successive panel by a novel treatment at the main gusset plates, which are spliced into webs. The webs are connected by lacing on each flange. The splices are of the lap type and are arranged immediately beyond the gusset plates. The various sections varied in weight, those adjoining the main post being about 84ft. long and weighing 45 tons per web.

The web members of the trusses are of simple design with splices in the longer diagonals. The gusset plates at the mid-points were riveted to the lower diagonals and required somewhat careful treatment in design on account of their size. Secondary members are introduced over the main pier, that on the anchor arm side bracing the main post and carrying load from the floor sub-panel concentrations, while that on the cantilever arm side is redundant and for appearance only, with a sliding connection at one end.

The anchor arms are connected at the anchor piers to anchorage grillages built into the body of each pier. Each grillage consists of a four-web structural detail engaging the mass of the pier. The connection is by means of structural members 50ft. long, pin-connected at either end to the anchor arm and anchorage grillage respectively, the pinholes being bushed for pins 12in. in diameter. The members are of rigid construction. The suspended span swings from the ends of the cantilever arm on structural hangers about 60ft. long, pin-connected at either end, the pinholes being bushed for pins 17in. in diameter.

The floor system is raised above the plane of the bottom chords and laterals and is carried on floor beams 6ft. 8in. in depth, which frame into the lower verticals immediately above the bottom chords, or into the sub-verticals at the mid-panel points. The tramway tracks are supported on built stringers, rigidly braced under each track. The roadway slab rests on 10in. I-beams about 4ft. apart, laid transversely on five lines of built stringers which are braced together at intervals by cross frames. These longitudinal tramway and roadway stringers frame into the floor beams, being connected to the stiffeners with special brackets at expansion points. The sidewalk stringers are outside the trusses and are carried on brackets.

(To be continued.)

The Training of an Engineer.

By Professor F. W. BURSTALL, Vice-Principal of Birmingham University.

MOST people who are reaching the end of their working life are inclined to take a general survey of their labours of the past, and in many cases can see numerous defects in their past work. Such a review is probably in the minds of all teachers, and it is my excuse for attempting to forecast the developments of engineering education, after an experience as a Professor doing active teaching for nearly thirty-four years.

The general principles of engineering training which have come down from the past are largely the work of certain very brilliant Professors such as Rankine, Osborne-Reynolds, Unwin, and other Professors on the Continent, who have endeavoured to concentrate attention on the study of the fundamental properties of matter in their relation to the construction of machines. In addition to this, there has always been a feeling that an education in which all the actual processes of manufacture are combined with the psychology of commercial undertakings is an essential part of the training of an engineer. Every teacher of engineering must realise that in his teaching of the fundamental laws of nature he is only dealing with a small portion of that which goes towards the make-up of the man who will ultimately be able to make a good position for himself in engineering.

It is, of course, unfortunate, from the aspects of pure scholarship, that one should have to dwell upon the bread and butter side of life, but it is essential in preparing men for any type of career in the commercial world. The engineering teacher will recognise these limitations of his work, and will endeavour to train the student on real fundamentals of mathematics, physics and chemistry, and will strive to show the manner in which these subjects enter into the construction and use of all types of machines. Any endeavour to confine the teaching purely to the particular forms which engineering is assuming at any given time will, of course, only have a transitory value, and no doubt this is the reason why so many teachers have confined their energies to what I term the "Symbolic" side of engineering practice—that is, the calculation and determination of the properties of materials and gases which are used in engineering. The commercial side, and more especially aspects of production, are hardly touched upon in a modern University course. This appears to me to be the side of engineering teaching in the Universities which requires to be developed, without in any way impairing the value of the knowledge which is entirely derived from the facts of nature.

The science of production of metal articles, whether singly, in small numbers, or in large quantities, is a fluctuating science, and it is, moreover, one which admits of a number of solutions, the best of which will depend upon a number of commercial considerations at any given time. This, of course, makes the attempt at teaching the principles of productivity a matter of the greatest difficulty as compared with the teaching of purely physical subjects. At the same time, it is one which is well worth the closest attention, and it can be reduced almost to the position of a mathematical calculation, with the difference that the constants employed in the determination of the correct method for production are variable from time to time; for example, they depend upon a current rate of interest of money, amounts to be allowed for depreciation and obsolescence, and the size of possible markets. Still, when the problem is that of the best method of producing an article which is not of an extremely simple form, or when one unit has to be considered, the matter probably can be settled by careful calculations of alternative methods of production and a final consideration of all the parts that are involved. Such a calculation is, in general, performed in the same manner by every commercial man when a new proposition is placed before him; but in many cases the drawbacks from which he suffers are that the facts, the data, and the number of alternative methods of manufacture are not fully considered at one time.

I have made attempts at teaching of this character, and have found the students immensely interested and very responsive to such questions. It obviously is not so much a matter of lectures as of seminar teaching and of setting a number of problems to the

student as to how a particular question has to be tackled. Matters of detail of manufacture are, of course, not essential, but problems such as whether a particular job shall have a simple or an elaborate jig, or whether it is worth while constructing a number of special machines of a cheap and inexpensive character for the manufacture of a particular article should be decided by a man of wide knowledge and broad vision, and it should not be left to a subordinate to work out the details of production, such work not being considered worthy of the attention of the best mind possible.

The whole production of engineering articles has been vitally changed in the last twenty years, and I venture to prophesy that it will be as much changed in the next twenty, and that many of the processes and methods which old-fashioned engineers have looked upon as final will be abandoned in favour of simpler and more foolproof machines. As an example of what is meant, consider the Capstan Lathe carrying six tools and producing an article which has to be made to very narrow limits. A complex machine of this character containing many bearing surfaces and slides is certain to go out of truth in a comparatively short time. If the process had been divided over six machines, each very simple and robust, these machines, having so few working parts, would keep their alignment and accuracy for a longer time than a more complicated machine, and the total cost might not be in excess of that of the complicated Capstan Lathe. I am constantly struck with the fact that in our machine tools of to-day we provide for a great number of operations which are only very rarely performed, and in doing this we, of course, detract from the rigidity of the tool. I look for all future developments of metal-cutting tools to be in the direction of simplification and the splitting-up of the operations so as to reduce the risk of breakdown and inaccuracy, and that manufacturers will in future face with equanimity the prospect of constructing a tool and putting it on the scrap heap when the market for its product has diminished. It is a mistake to maintain tools in production simply because they are capable of their work. The correct rule should be that they should only be retained when their operation yields maximum profit to the user. The care and attention given to the design of a Capstan Lathe ought, in my view, to be now devoted not to the production of the machines, but to the methods of moving the work from one machine to another. In other words, development in the future will be devoted largely to the construction of automatic and semi-automatic handling machines, and it is here that I anticipate the largest developments in engineering. We are, to-day, using our hands and various lifting appliances in a very inefficient way, and in many cases such effort can be replaced by very simple and foolproof machinery.

Apart from purely technical considerations, it is vitally important that the student should learn to write correct and simple English, so as to be prepared to present a report on any subject which will give in terse language the information that is required by his superior officer. This writing of English is by no means general among engineering students, and requires direction during the student's course, from the Professor. The main objection to these suggestions by the teachers will be that the curriculum is already overcrowded during the three years' course, and that it is an impossibility to introduce fresh subjects without overloading the students, and there is much truth in this comment. The actual technical and scientific course requires to be overhauled, and a certain amount of redundant and obsolete matter cut out. This could be readily done without really affecting the fundamental principles of mathematics and mechanics, especially as now students enter the University from a good Public or Secondary School with a Higher School Certificate, and thus much of the elementary scientific work has already been well done. Mathematics, both pure and applied, is generally the most serious stumbling block to the average engineering student, not because he is incapable of grasping mathematical principles, but rather because he is often overburdened with a good deal of work, valuable in itself, but which could be easily omitted for the engineering student. In actual technical courses certain subjects—such, for example, as the theory of machines—can be dropped. The mechanical engineering student only requires general knowledge of electrical practice, and it is unnecessary for him to do any elaborate calculations on magnetism or the design of dynamos or motors. In the higher side of kinematics, elasticity, and the heat engine, the work can be made both definite and duly scientific, based on general principles, and may cover all that is necessary for the first degree work in a shorter time than at present is employed. The drawing-office should in all cases receive most careful attention, not merely for the purpose of training a man in the art of handling the pencil, but rather to train his intelligence and make him think over designs. Except in the early stages of the work, no copying should be allowed. The student should design with the aid of current knowledge, and then have his faults rectified by the teacher in friendly discussion over the drawing board.

Experimental work in the engineering laboratories is valuable in teaching how an experiment should be made, and the results put altogether, and, in addition, it gives the familiarity with various types of engines, boilers, and materials, which it would be difficult to obtain in any other manner. In general, laboratory work would occupy the latter half of the student course.

The question of workshop training in a University raises some very important educational issues. In former times it was rightly claimed that practical experience under commercial conditions of manufacture could only be obtained in an engineering firm manufacturing a wide variety of products, and that work carried out in a University or College was little more than "playing with tools," and that the student would learn nothing of practical work. Under modern conditions, it is very difficult for an engineering apprentice passing the whole of his time in the shops to obtain a reasonably wide engineering experience. Work is now specialised to a degree unknown even ten years ago, and in those shops no knowledge can be obtained beyond that of the very limited product which the firm is manufacturing. This process of specialised manufacture and the disappearance of the general engineering firm is bound to continue and extend, and there soon will be no place in which even an engineering mechanic can be adequately trained.

It is not possible here to deal with the wide question of the engineering training of the technician or of the mechanic, important as they are to industry generally. The only side which can be adequately discussed at present is the training of men for positions of responsibility and control in manufacture. To such men, as to all others, an intimate knowledge of the technique of manufacture is essential. They must know the general properties of tools, and, above all, must understand the psychology of the workshop, which probably is the most valuable thing that most of us have acquired from our apprenticeship days.

At present the only method by which a University student can obtain practical knowledge is the very limited opportunity offered to him in the vacations, and perhaps on a short period of shop training, after the completion of his University course. Under these conditions, it becomes almost imperative for the Universities to offer some type of manual training under their own control, and judging from the experience of nearly a quarter of a century of this method, it undoubtedly helps to give the student a foundation. No attempt should be made to give manual skill, the whole object is to familiarise the student with the appliances used in engineering manufacture, and if the University workshops are well equipped and carry out a variety of work on repair and construction of various machines, the student can obtain, even in a short time, a reasonable facility in workshop practice.

Many distinguished engineers in this country hold strong views on the question of a period of pupilage in the works for two or three years after the conclusion of University work, and none would deny that such a training is in every way admirable. Like many other ideal conditions at present, it is very difficult to carry out this plan. To begin with, the young man of twenty-one years is not inclined to spend a further two or three years learning in the workshops. In the majority of cases such a course is impossible for financial reasons, it being imperative that after the young man has been supported with scholarships during his career he should at least be able to earn a living wage, and hence the more brilliant of the mechanical engineering students wish to get into remunerative employment at once, and at present so great is the demand for well-trained engineers that they have comparatively little difficulty in doing so. The long time required for both a full University course and a period of pupilage under practical conditions is largely responsible for the small numbers who are taking up mechanical engineering. Parents cannot afford the expense attached to such a course, and if the industry really demands men of first-rate ability to maintain itself in competition with other countries, they must be prepared to carry the expenses of training the young man at the end of his University career until he becomes fully competent. Many new points of view have come into prominence with this post-war period, which must be taken into account if future leaders of industry are to be fully equipped, and sufficiently numerous to keep this country in the forefront of industrial progress.

The fall of the birth-rate among the professional and middle-class people, who in the past have supplied the great mass of first-rate ability, is a most important factor. It may be that there is sufficient latent ability in the mechanic and other classes to supply this want. With so many new professions open to the brilliant boy and with commerce offering such substantial rewards at an early age, the leaders of the mechanical engineering industry will have to assist the Universities in the training of the right type of student for their needs.

IN reply to questions in the South African House of Assembly, the Union Minister of Posts and Telegraphs stated recently that orders had been placed for the installation of automatic telephones in Johannesburg and Cape Town with Siemens Bros. and Co., Ltd., and the Automatic Telephone Manufacturing Company, Ltd. The cost of the total conversion covered by the contracts would be approximately £750,000 over a period of five years.

The Influence of Pipe Diameter on Orifice Discharge Coefficients.

By F. C. JOHANSEN, B.Sc., A.M.I. Mech. E.

THE diaphragm orifice mounted in a pipe line provides a form of fluid meter at once so simple and so readily installed as to recommend its employment in a large variety of engineering and industrial processes. The device has, in consequence, been the subject during recent years of considerable research, mainly directed to the determination of the relations connecting the rate of discharge, the size of the orifice, and the drop of pressure between the upstream and downstream sides of the orifice. As the outcome of such investigations, the influences on the discharge coefficients, of Reynolds number, and, more particularly, of the aperture ratio—*i.e.*, area of orifice aperture ÷ cross-sectional area of pipe—have been widely explored, and are now generally well known to users of orifice meters. But, in addition to these, other variations of discharge coefficient have been observed, arising from less obvious causes, and among them is a systematic change of coefficient accompanying a variation of the diameter of the pipe in which the orifice diaphragm is mounted, of which unmistakable evidence is forthcoming from several recent researches in which the scope of the calibrations has been sufficiently extensive to cover a wide range of pipe sizes. This effect, while distinct from what may be termed the major influences of Reynolds number and aperture ratio, is, as may be expected, subject to modification by them. It has not received much attention, possibly on account of the fact that the discrepancies which it introduces are unlikely to exceed a few per cent. of the measured discharge. Since, however, the possible error appears to be appreciably in excess of the commonly accepted limits of accuracy in fluid metering, a brief examination of some of the available data may be of value in indicating the relative importance and the true character of the influence ascribed to pipe diameter, and in suggesting precautions whereby faulty metering may be avoided.

For this purpose an analysis has been made of three quite independent researches, all of which exhibit what, for convenience of expression, may be termed the "diameter effect." Each is the work of an investigator of repute, and this feature, no less than the systematic character of the effect, the exhaustive scope of the work, and the technique employed, precludes the possibility of the divergencies under consideration being the outcome of experimental error. The salient features of the calibrating equipment used are shown in the diagrams on page 680.

The earliest report is by J. M. Spitzglass,[1] of the Republic Flow Meters Company, whose data are from pipes of 3in. to 12in. bore. More recently, Jakob and Kretzschmer[2] have carried out very complete tests on orifices in pipes ranging from 10 cm. to 100 cm. diameter. In both these cases the calibrations were made with air at about atmospheric pressure. It is therefore of interest to include, for comparison, a series of coefficients derived from the flow of water, by Witte,[3] who used pipes from 5 cm. to 50 cm. diameter. All three investigations were made with circular orifices concentric with the pipes in which they were mounted. Whilst, however, Spitzglass used plane diaphragms $^1/_{32}$in. thick, with square-edged orifices, the German work was done with orifices bevelled on the downstream side. This minor difference in equipment may cause some discrepancy between the American and German coefficients, but it can hardly be a factor producing diameter effect, since the latter is evident from the results of each separate observer. Each series of tests extends, of course, over a range of orifice aperture ratios, and the variation of the diameter effect accompanying change of aperture ratio is one of the more interesting features which appear, since it provides a clue to the primary cause of an effect which is almost certainly due only indirectly to pipe diameter.

The comparison of these three investigations has necessitated reduction to a common basis of the results as originally presented. With the object of facilitating comparison with data on orifice flow published in England,[4] the discharge coefficients in the accompanying table are defined by—

$$C_D = \frac{Q}{a}\sqrt{\frac{\rho\,[1-(d/D)^4]}{2\,h}}$$

	Dimensions.
where Q = rate of volumetric discharge	$(L^3\,T^{-1})$
a = cross-sectional area of orifice	(L^2)
h = pressure drop across the orifice	$(M\,L^{-1}\,T^{-2})$
ρ = density of the fluid	$(M\,L^{-3})$
d = orifice diameter	(L)
D = pipe diameter	(L)

In this definition the fluid is considered incompressible and the pressure across the orifice is regarded as being measured in the angle between the pipe wall and the orifice diaphragm, close up to the latter. This practice was followed in the case of the two German investigations. Spitzglass's coefficients, how-

[1] "Trans.," Am. Soc. Mech. E., Vol. 44 (1922), page 919.
[2] Vorschungsarbeiten, V.D.I., Verlag, Berlin, No. 311 (1928).
[3] V.D.I. Zeitschrift, Vol. 72 (1928), page 1493.
[4] *cf.* J. L. Hodgson, "The Orifice as a Basis of Flow Measurement," Inst. C.E. Selected Engineering Papers, No. 31, 1925.

ever, are based on pressures measured at points appreciably distant from the orifice and have required, in consequence, some adjustment to admit of comparison with the other data. (This computation renders the absolute values of Spitzglass's coefficients somewhat uncertain, but does not, of course, affect the relations between his values for pipes of different diameter.) The results of each research, taken from the precise source named in the footnote,[6] for three values of aperture ratio, have been plotted against pipe diameter, and values of C_D corresponding to a range of diameter from 7·5 cm. to 100 cm. are collected in Columns 1, 2, and 3 of Table I. From these the values of Columns 4, 5, and 6 have been derived by selecting, arbitrarily, the 10 cm. diameter pipe as a basis of comparison and expressing each observer's coefficients as a decimal of the coefficient for the 10 cm. pipe. Thus, for an aperture ratio 0·4, Witte's coefficient for a 40 cm. pipe is 0·604, which is 0·982 of his value (0·615) for a 10 cm. pipe.

TABLE I.

		Discharge coefficient C_D.			$C_D \div (C_D$ for 10 cm. pipe).		
Column	.. .. ..	1	2	3	4	5	6
Aperture ratio $(d/D)^2$.	Pipe internal diameter D, cm.	Spitzglass.	Witte.	Jakob and Kretzschmer.	Spitzglass.	Witte.	Jakob and Kretzschmer.
	7·5	·619	·616	—	1·003	1·005	—
	10	·617	·613	·611	1·000	1·000	1·000
	20	·612	·609	·610	·992	·993	·998
0·2	30	·608	·605	·607	·985	·987	·993
	40	—	·604	·604	—	·985	·988
	50	—	·603	·601	—	·984	·984
	100	—	—	·598	—	—	·979
	7·5	·626	·618	—	1·006	1·005	—
	10	·622	·615	·622	1·000	1·000	1·000
	20	·613	·610	·619	·985	·992	·995
0·4	30	·607	·606	·614	·975	·985	·986
	40	—	·604	·612	—	·982	·984
	50	—	·602	·608	—	·979	·977
	100	—	—	·598	—	—	·961
	7·5	·614	·610	—	1·007	1·007	—
	10	·610	·606	·626	1·000	1·000	1·000
	20	·598	·599	·618	·981	·988	·987
0·6	30	·590	·594	·610	·967	·980	·974
	40	—	·589	·604	—	·971	·965
	50	—	·585	·598	—	·965	·955
	100	—	—	·584	—	—	·932

It would have been desirable, from the point of view of comparison among the three investigations, to have reproduced discharge coefficients relating to the same value of Reynolds number. Definite values of this criterion are, unfortunately, quoted only by Jakob and Kretzschmer. The coefficients of Column 3 for these workers are for a Reynolds number—based on the mean flow through the orifice—of 100,000, this value being considered to be of the same order as those for Spitzglass and Witte, whose pipe sizes are on the whole smaller than those of Jakob and Kretzschmer. From the published results of these last workers, however, which extend up to Reynolds number 700,000, it appears that whilst change of Reynolds number, between these limits, affects the actual values of the discharge coefficients, it produces no important change in the relative values of the coefficients over a range of pipe diameters. An examination of the diameter effect observed[6] by Jakob and Kretzschmer at Reynolds number = 700,000 reveals that for each aperture ratio the reduction of C_D with increase of pipe diameter is of the same order as, but consistently somewhat greater than, at Reynolds number = 100,000.

The most obvious features of Table I. are apparent from Columns 4, 5, and 6, where it will be seen that for each aperture ratio and each series of tests the influence of pipe diameter is to reduce the value of C_D as the diameter is increased. The reduction is continuous, but is more rapid at small than at large diameters, a tendency being observable for the effect to approach a limiting value as the largest pipe diameters are attained. By comparison with the arbitrary standard for D = 10 cm., the divergence in the value of C_D is, in general, of the same order of magnitude at each pipe diameter for each of the three observers; such discrepancies as appear, from columns 1, 2, and 3, in the absolute values of C_D may be due to differences of orifice shape and Reynolds number, but do not concern the diameter effect.

It will be further observed that the influence of pipe diameter is more marked at large than at small aperture ratios. Thus, as between tests in pipes of 10 cm. and 100 cm. bore, the discrepancy in C_D is about 2 per cent. at $(d/D)^2 = 0·2$; 4 per cent. at $(d/D)^2 = 0·4$; and 7 per cent. at $(d/D)^2 = 0·6$. Whilst this is an undesirably wide range of uncertainty, it is one which may quite possibly occur in large installations where, on account of the difficulty of calibrating a large-scale plant, coefficients derived from tests of small-scale orifice meters are in use. The augmented effect accompanying the larger aperture ratios is a further point of practical importance, since the fact that the overall loss of head through and beyond an orifice meter decreases with increased aperture ratio encourages a tendency to make use of the largest orifices—up to $(d/D)^2 = 0·5$ approximately[7]—for which consistent discharge coefficients are obtainable.

The manner in which discharge coefficient comes to be influenced by the absolute size of the pipe containing the orifice is somewhat obscure. At first sight it would appear, indeed, that when compressibility effects are negligible, the only physical quantity, in addition to those specified above in connection with the definition of C_D, which can affect the flow through a pipe orifice is the viscosity of the fluid μ, having dimensions $(M L^{-1} T^{-1})$. On this hypothesis a dimensional analysis of the problem leads to the result that—

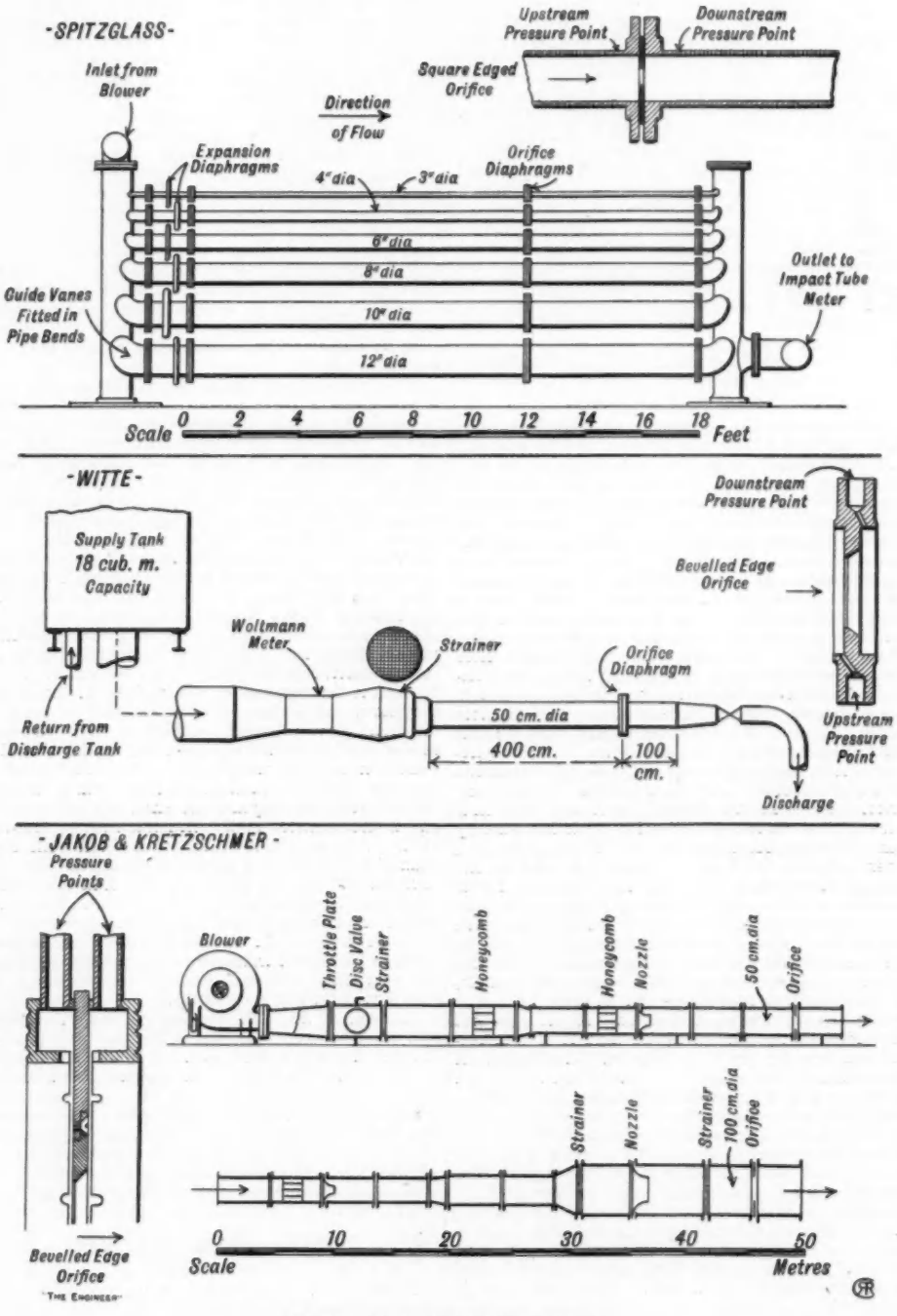
$$h = \rho (Q/a)^2 f_1 (d/D, v d \rho/\mu)$$

or

$$C_D = f_2 (d/D, v d \rho/\mu)$$

where f_1 and f_2 are general functions and $v = Q/a$ is the mean velocity through the orifice. This equation shows that C_D may be expected to vary with aperture ratio (or d/D), and with Reynolds number $(v d \rho/\mu)$, and both these influences are well known. So far from indicating a variation of C_D with diameter, however, the equation definitely asserts that no such variation is possible. Since this deduction is contrary to experimental fact, it is evident that the postulates regarding the physical quantities affecting the flow through the orifice are incomplete; and the obvious suggestion occurs that these should include quantities which define the condition of the pipe surfaces in contact with the fluid and the geometry of the whole installation in which the orifice is mounted. As a matter of fact, in none of the investigations here considered was either of these strict conditions for geometrical similarity, as between one size of pipe and another, fulfilled. The overall lengths of the pipes containing the orifices were about the same irrespective of diameter, and the pipe surfaces appear to have been of about the same absolute roughness, *i.e.*, the average height of surface asperities was the same for all diameters. For strict geometrical similarity these quantities should have borne a constant relation to the diameter of the pipes for each series of calibrations, and the divergencies from this requirement offer a probable explanation of the observed influence of diameter on discharge coefficient.

It is of interest to note that both roughness and



VARIOUS CALIBRATING EQUIPMENTS

[6] Spitzglass, A.S.M.E., Vol. 44, Tables 8–13, pages 949–51; Witte, V.D.I. Zeits., Vol. 72, Fig. 21, page 1498; Jakob and Kretzschmer, Forschungsarbeiten 311, Fig. 81, page 25.

[6] *Loc. cit.*, Fig. 84.

[7] *cf.* Hodgson, *loc. cit.*

length of pipe upstream of the orifice exert an influence on the flow by their effects on the distribution of velocity across a diameter of the pipe. If, for example, air is being drawn through a long pipe open at one end to the atmosphere, the transverse velocity distribution near the inlet is uniform except in the immediate neighbourhood of the pipe walls. As the air passes along the pipe, the skin friction communicates a retarding effect to layers of air increasingly remote from the walls, until finally a limiting condition is reached in which the distribution of velocity changes continuously across the pipe and the mean velocity is only about 0·8 of the maximum velocity at the axis. The length of pipe traversed before this final distribution is established will vary, in general, with the nature of the pipe surfaces and the Reynolds number for the flow. Prandtl,[8] commenting on the diameter effect observed by Witte, regards 50 diameters as a minimum, whilst Stanton[9] considers 70 or more diameters requisite. Thus, a curve showing the ratio—

$$\frac{\text{mean velocity}}{\text{axial velocity}}$$

plotted against length of pipe will descend rapidly from unity at the inlet of the pipe and become asymptotic to a value of about 0·8 in the region of 50 to 100 pipe diameters. Stanton[10] has further shown that the velocity distribution across rough pipes is markedly less uniform than that across smooth ones.

The main feature of the transverse velocity distribution in the pipe upstream of an orifice is, therefore, that what may be termed the velocity profile of the fluid is likely to be flatter for short and smooth upstream pipes than for long and rough ones. In the latter case, where the peak of the velocity profile is more pronounced, a larger proportion of the total flow takes place near the axis of the pipe; and since the orifices are concentric with the pipe axis, it is reasonable to suppose that the retarding effect of the orifice annulus is less pronounced for the peaked than for the flat profile. For the same actual discharge, under conditions differing only in transverse velocity distribution, the peaked profile will therefore result in a smaller differential head across the orifice and a larger discharge coefficient. Such an effect should, moreover, be more pronounced for large than for small aperture ratios. With a small orifice in a large pipe, so great a proportion of the total flow is deflected by the diaphragm that the existence of relatively high velocities near the pipe axis is, proportionately, less effective in reducing the resistance through the orifice, and thereby increasing the coefficient, than is the case with a large orifice aperture ratio.

It will be evident that the conclusions to be drawn from the hypothesis, that the so-called diameter effect arises from variations in the transverse velocity distribution, are in accordance with the experimental facts of these three researches. First, since the length of straight pipe upstream of the orifice was about the same for all the pipe diameters of each separate research, it follows that the ratio—upstream length ÷diameter—is smaller for large than for small bore pipes. The velocity profile may therefore be expected to be flatter in the large pipes and the discharge coefficient smaller than is the case with small-bore pipes. This is consistently the case, as shown by Table I., for each investigation. Secondly, as Jakob and Kretzschmer have observed, since the surface irregularities are of about the same size in all the pipes of any one series, all the pipes are of about the same absolute roughness. It is, however, the relative roughness, or relation of size of irregularities to pipe diameter, which affects the flow, and on this basis the large-bore pipes are relatively smoother than the small ones. For the large pipes, therefore, the velocity distribution should be more uniform and the discharge coefficient smaller than for small pipes—a deduction which is again in accordance with the observations.

Thus, pipe roughness and length of straight pipe upstream of the orifice are both probable contributors to the effect on C_D apparently due to pipe diameter, and it remains to consider the relative importance of the influences they exert. In this connection, it is of interest to compare the difference in transverse velocity distribution which may arise from roughness with that which may result from the different lengths of pipe traversed by the fluid before it reaches the orifice. As regards the first of these causes, the integration of Stanton's[11] distribution curves shows that the ratio V mean÷V max. amounts to 0·81 for a smooth pipe and 0·76 for a rough one. This relation holds, of course, for the ultimate transverse distributions established after the fluid has traversed an adequate length of pipe. Against this difference in V mean/V max. must be contrasted that which may take place over the range of upstream pipe lengths included by the various experimenters. Spitzglass's upstream lengths, for example, ranged from 12 to 48 diameters; Witte's from 8 to 20. Now, of the overall drop in V mean/V max., amounting to 1−0·81 (=0·19) or 1−0·76 (=0·24)—according to whether the pipe is smooth or rough—about one-half occurs whilst the fluid is traversing the first 8 diameters from an open end. Between 8 and 70 diameters, the remaining fall in V mean/V max. take splace. It seems probable, therefore, that the change in V mean/V max. due to upstream lengths of 12 to 48 diameters, or 8 to 20 diameters, is somewhat smaller than that which may occur from differences in relative surface roughness. Stanton's roughness range is an extreme one, of course, extending from fairly smooth pipe walls to surfaces artificially roughened by screw cutting. On the other hand, it will be realised that in the experiments under consideration the pipe length upstream of the orifice did not terminate at an open end, so that the velocity profile was probably somewhat peaked at the entrance to the straight upstream length.

The data of each of the investigations of Table I. appear to support the contention that relative roughness is more important than upstream length. It has already been mentioned that the diameter effect is less marked with large than with small pipes. This feature, for example, is quite evident from the values of Spitzglass, which relate in every case to an upstream length of 12ft. Now, if the variation in the ratio :—upstream length÷diameter were the main cause of the differences in velocity profile, a tendency should exist for the latter—*i.e.*, for diameter effect—to be more apparent at large than at small diameters. Table I. shows, however, the that contrary is the case.

More direct evidence bearing on this point is provided by Witte,[12] who, in replying to Prandtl's comment on diameter effect, refers to some earlier experiments of his own in which he found that an increase of upstream length from 10 to 23 diameters had no measurable influence on discharge coefficient. The present writer[13] has similarly been unable to detect any change in C_D when the length upstream of the orifice was varied between 23 and 46 pipe diameters.

The view that diameter effect is mainly brought about by variations in relative pipe roughness appears to be held by the authors of the data reproduced in Table I., and it certainly is the one which accords most closely with the experimental results.

Thus, for a small-bore pipe the relative roughness is large, the velocity distribution profile is more sharply peaked, and the discharge coefficient is larger than for a large-bore pipe. This effect is more apparent at large than at small orifice aperture ratios. And, finally, for a series of pipes of ordinary commercial finish, the relative roughness will decrease with increase of diameter until a stage is reached when the relative roughness is practically zero, and a large pipe thus approximates closely to a perfectly smooth one. A decreasingly marked diameter effect as diameters are increased is in accordance with this conception, and occurs for each research and each aperture ratio examined in Table I.

In an endeavour to clear up the effect of diameter on orifice coefficients, Witte[14] has carried out further experiments on orifices in pipes up to 100 cm. diameter, with an equipment in which the length upstream of the orifice extended for at least 11 diameters. From these he concludes that for pipes above 50 cm. bore no diameter effect is apparent, and that for all practical purposes 30 cm. bore may be regarded as the upper limit of diameter effect. This view is not substantiated by Jakob and Kretzschmer, whose coefficients, though tending towards limits at large diameters, decrease continuously as far as pipes of 100 cm. bore. In the absence of data regarding the surfaces of the pipes actually used, it is not possible to arrive at any definite conclusion on a matter which probably depends very largely on the degree of absolute roughness present in a particular case.

Some further experiments by Witte provide a satisfactory confirmation of the probability that diameter effect is largely an effect of relative roughness. Using water he made a comparative series of tests on orifices in two sets of pipes of diameter 5 cm., 10 cm., and 20 cm. One set of pipes had surfaces of ordinary roughness; the others were turned and polished internally, so as to be as smooth as possible. The results for 5 cm., 10 cm. and 20 cm. pipes respectively show discharge coefficients for the rough pipes of the order of 2, 1, and ½ per cent. greater than for the smooth pipes. For any one diameter, moreover, the ratio :—C_D (rough)÷C_D (smooth) increases with increase of aperture ratio. The rough pipe coefficients are, as in Table I., consistently larger for small than for large pipes; whereas the coefficients for the smooth pipes are constant for all three diameters, and—a significant point—are in very close agreement with Witte's coefficients for orifices in pipes of ordinary roughness, 100 cm. diameter. Here, then, is good evidence that for perfectly smooth pipes and adequate length upstream of the orifice, the so-called diameter effect no longer exists.

As a final demonstration of pipe diameter influence on discharge coefficients, the comparative values of Table II. have been collected from the mean data of four different investigations covering a range of pipe diameters from 1 cm. to 100 cm. It is not possible to assert that the whole of the exhibited divergence in C_D is due to variations of relative pipe roughness. Hodgson's values, for example, are for thin square-edged diaphragms, whilst the others are for orifices of the bevelled-edge pattern. Although, too, the coefficients relate in every case to completely turbulent flow, the appropriate Reynolds number is somewhat different in the four sets. Various considerations suggest, however, that relative pipe roughness is mainly responsible for the change in C_D with pipe diameter. As regards the effect of orifice edge, for example, Witte has tested the effect of orifice edge-thickness on C_D and finds it, within wider limits than those of the orifices which furnish the data of Table II., to be inappreciable. Again, with regard to the effect of Reynolds number, Hodgson's[15] coefficients are limiting values for Reynolds number about 75,000, above which no change of C_D is apparent; and although Jakob and Kretzschmer[16] record a continuous change of C_D as Reynolds number is increased from 50,000 to 700,000, the effect of increased Reynolds number is to increase the discharge coefficient, which is in the direction to enhance the discrepancy in C_D, shown in Table II.

TABLE II.

Observer ..	Hodgson.[17]	Johansen.[18]	Jakob and Kretzschmer[19]	Witte.[20]
Pipe diameter, cm.	0·95 to 1·9	3·2	100	Smooth pipes
Aperture ratio $(d/D)^2$	<——	—Discharge	Coefficient C_D	——>
0·15	·622	·617	·606	·601
0·30	·628	·624	·615	·605
0·45	·628	·624	·616	·606
0·60	·616	·613	·606	·594

A comparison of the four sets of results shows a continuous decrease of discharge coefficient with increase of pipe diameter and a maximum discrepancy amounting to 3½ per cent. between the results of Hodgson's and Witte's very carefully conducted researches—a degree of uncertainty which must be frequently exceeded under conditions less favourable than those of a laboratory. To attribute most of the divergence shown in Table II. to variations of relative wall roughness seems reasonable. In the absence of data regarding the types of pipe employed, this probable conclusion should not, however, be unduly stressed, more especially in view of the fact that Table II. does not show an augmented diameter effect associated with the larger aperture ratios.

Spitzglass's coefficients have not been included in Table II., since, as has been mentioned, his pressure points were situated at a distance from his orifices, with the result that his coefficients can be estimated only approximately. It may be mentioned, however, that his coefficients for a 7·6 cm. diameter pipe are estimated to be in close agreement with those of Column 2, Table II—due to the writer—over the range of aperture ratio 0·15 to 0·60.

The analysis which has been made suggests one or two precautions which may be adopted with advantage when high accuracy in orifice flow meters is sought. An orifice should, if at all practicable, be calibrated after installation in the equipment where it is to be used as a flow meter, and should be tested over the whole range of Reynolds numbers to be encountered in service. When, as will frequently be the case, this course is inadmissible, a scale model, including all special features likely to affect the orifice flow and with internal surfaces prepared to simulate the relative roughness of the prototype, should be calibrated over the full-scale range of Reynolds numbers. This precaution becomes particularly desirable if the straight pipe length upstream of the orifice is less than about 10 diameters. Finally, if discharge coefficients are employed without determination by special calibration, regard should be paid to the relative roughness of the installation, and an appropriate allowance given to the selected coefficient according to the nature of the equipment from which the latter has been derived.

ASSOCIATION OF CONSULTING ENGINEERS (INCORPORATED).—At the first meeting of the new Committee, held last week, Mr. A. H. Dykes, M. Inst. C.E., M.I.E.E., who has for twenty-one years acted as honorary secretary, was appointed Chairman of the Committee for the ensuing year, and Mr. S. R. Raffety, M. Inst. C.E., M.I. Mech. E. (Messrs. Rofe and Raffety), was appointed acting honorary secretary during Mr. Dykes' term of office. The address of the office will remain 11, Victoria-street, Westminster, S.W. 1.

LOUGHBOROUGH COLLEGE: BRITISH EMPIRE SCHOLARSHIPS.—The entrance examinations for the award of British Empire Scholarships in the Faculty of Engineering, Loughborough College, have now been completed and awards made. The Govenors of the College have approved the following awards for 1930 :—(1) Howell, J. C., Devonport High School; (2) Whitehead, J. R., Sutton Coldfield Grammar School; (3) Noble, N. E. D., Wellington College; (4) West, Fred, Swanwick Hall School; and (5) Cox, Cyril C., Loughborough Junior College. R. J. Gaul, of Plumtree, South Rhodesia, has been recommended for a present Scholarship which will be vacant in September next. These Scholarships are open to all British subjects resident in any part of the Empire, and are of the value of £75 per annum.

---

[8] V.D.I. Zeitzschrift, Vol. 72, page 1939.

[9] *Vide* "Proc.," Roy. Soc., A Vol. 85, page 367; "Phil. Trans.," A Vol. 214, page 202.

[10] "Proc.," Roy. Soc., A Vol. 85, page 366.

[11] Roy. Soc., A Vol. 85, pages 370–376.

[12] V.D.I. Zeitschrift, Vol. 72, page 1940.

[13] "Flow through Pipe Orifices at Low Reynolds Numbers," Reports and Memoranda of the Aero. Res. Ctee., No. 1252.

[14] "Technische Mechanik und Thermodynamik," Vol. 1 (1930), page 34.

[15] *Loc. cit.*, Figs. 4 and 7, and page 11.

[16] *Loc. cit.*, page 26, Figs. 85–92.

[17] Sel. I.C.E., Paper No. 31, Fig. 7, page 10.

[18] R. and M., 1252, page 23.

[19] Forschungsarbeiten 311, page 27.

[20] Techn. Mechan. u. Therm., Vol. 1, page 41.

The World Power Conference at Berlin.

No. I.

THE first World Power Conference was convened in London in 1924, on the occasion of the great Exhibition at Wembley. The object was to facilitate the personal intercourse of engineers from all over the world who were interested in the technical or economic aspects of the supply of power, and to afford means for a direct interchange of views between the experts of all nations. The circumstances were propitious, and the meeting-place was well chosen, but there can be no doubt that the Conference would not have been so completely successful as it was, had not the time been ripe for an organised interchange of experience between those faced with analogous problems in different parts of the world. The strength of the desire for international co-operation was shown by the fact that representatives of no less than forty different countries accepted the invitation to take part in the Conference, and manifested their interest by the contribution of more than 300 papers for discussion. After such a response there could be no question of letting the matter end with Wembley. The work had to continue, and with this object the National Committees representing the various countries elected an International Executive Council charged with the duty of arranging the time, place, and nature of future Conferences. It was felt that some few years would elapse before the developments of power engineering would call for another review of the situation as complete as that which characterised the Wembley meeting, yet, nevertheless, there would be in the meantime, ample scope for sectional conferences dealing with matters of special interest in connection with particular occasions. Four of such conferences have, indeed, been held since the original Plenary Conference at Wembley. At Basle in 1926 there was a water-power conference during the period of the Water Power Exhibition. An important fuel conference was held in London in 1928, while further sectional conferences dealing largely with the administration of public utilities were held last year in Barcelona and Tokio.

In view of the rate of progress in power development since 1924, the International Executive Council determined that this year should be marked by a second Plenary Conference, and Berlin was chosen as the most appropriate place for holding it. The Conference was officially opened on the morning of Monday, June 16th, and will close on Wednesday, the 25th, except for the official tours and visits to places of interest, which do so much to consolidate the human value of these international conventions. The importance which the World Power Conference has acquired in the field of international engineering is clearly shown by the arrangements made for its reception in the German capital, and by the number and quality of its participants. According to the figures available on the day of opening, 3442 members had signified their intention of being present, these coming from forty-eight different countries. Germany, as might be expected, headed the list with 1617 members, Great Britain, Japan, and the United States following with 195, 178, and 117 members respectively. Australia sent five, New Zealand two; while other distant lands without much engineering fame at present, like China, Peru, Ecuador, Siam, &c., also contributed their quota to the total. As regards the technical proceedings, the papers to be discussed are over 400 in number, the subjects ranging over every aspect of the ground covered by the title of the Conference. To deal adequately with the magnitude of the assemblies, the multiplicity of tongues, and the wide scope of the interests concerned, calls for organising ability of the highest possible order, and this has fortunately never been lacking since the idea of a World Power Conference was first conceived, and brought to fruition at Wembley in 1924 by Mr. D. N. Dunlop, the director of the B.E.A.M.A.

The subject matter of the Confe rence is divided into thirty-four sections, the papers coming under each section being summarised in a report which emphasises their important features and suggests the lines which the discussion could profitably take. No time is wasted in reading individual papers, which are available for members well in advance of the Conference. The danger of worthless papers or contributions tending more to trade propaganda or personal advertisement than to the advancement of useful knowledge, is eliminated by the requirement that every paper shall be submitted *vid* an authoritative body representing the country or the industry concerned. There are three official languages of the Conference—English, French, and German—and the difficulty of the discussions in an international assembly has been faced at the present Congress in an admirable way. Those who attended the first Conference at Wembley will remember how, sometimes, an impassioned speech of a quarter of an hour or more in a foreign language, was followed by an interpreter's version of it given in a minute or so. In such circumstances there was always a doubt whether the translation really and effectively covered the same ground as the speaker. At Berlin the arrangements are much fairer, both to the speakers and to the audience. The speaker uses his own language, a microphone in front of him amplifying the sound which is received by each member of the audience through a headphone. His own audibility is thus secured, however badly he may speak or however bad the acoustics of the room. At his side or below him are two interpreters who simultaneously repeat his words into other microphones, but in the other official languages of the Conference. Every member of the audience therefore can listen either to the speaker or to one of the interpreters by merely turning a knob which switches his headphones on to the microphone which is receiving the speech in the language desired. It would be too much to say that the functioning of the apparatus was perfect during the earlier meetings of the Conference at Berlin, but, apart from occasional blasts of cross-talk and "atmospherics," the actual words of the speaker or their simultaneous translation were clearly receivable by every man in the room who cared to put his headphones on. For the provision of this convenience, not to say necessity, of an international meeting, the German National Committee must be given the credit along with that due to them for the whole organisation of the Berlin Conference, the arrangements for which were very good indeed.

The proceedings of the Second World Power Conference really began on the evening of Sunday, June 15th, when the members and delegates were received by the Honorary President, his Excellency Doctor Oskar von Miller, and the Chairman, Dr. C. Köttgen, in the Reichstag building. The Earl of Derby, who had held the presidential chair of the organisation since the previous Conference at Wembley, handed over the insignia of office to Dr. von Miller, with a graceful speech, indicating the magnitude which the organisation had achieved, and calling to mind the great work of his successor in establishing the "Deutsche Museum." Dr. von Miller, in reply, referred to his own very early interests in electrical power supply, when fifty years ago he had begun to develop the then little-known water powers of the Alps and Carpathians, and had subsequently been one of the very early pioneers in electrical transmission by establishing the first long-distance line from Lauffen to Frankfort. A message of welcome from Von Hindenburg, the President of the Republic, and the placing of the Reichstag at the disposal of the Conference for the welcome of the members, bore witness to the good wishes of the German Government for the success of the meeting. The immense crowd that thronged the halls of this great edifice could hardly have been accommodated with such comfort in any other building in the city, so that the members could not help feeling how much the sentimental value of the honour they received was enhanced by the practical nature of its manifestation.

The official opening ceremony of the Conference was held at the Kroll Opera House on Monday morning, when the stage was crowded with official delegates, a number of whom delivered messages from their respective countries. The strong glare of the stagelights, trying as it must have been for the delegates submitted to it, rendered their features distinct to members in the remotest parts of the vast auditorium and microphones rendered their words equally distinct. Sir Charles Parsons, the British Vice-President of the Conference, spoke on behalf of Great Britain, and received a welcome of marked enthusiasm. Tickets of admission were handed out to the members until every seat in the Opera House was filled, and those unable to gain an entrance were enabled to enjoy the speeches without the scenic effect by listening to their reproduction by loud speakers in one of the halls of the adjoining Conference Building.

Turning again to the technical aspects of the Conference, a few facts concerning the papers submitted for discussion may appropriately be given before reference is made to the papers themselves. In all, 401 papers were received from thirty-one different countries. So far as it is possible to classify such a collection under a reasonable number of headings, it may be said that electrical matters form the subject of 132 papers, steam power of 63, water power of 49, solid fuels of 34, gaseous fuels of 33, internal combustion engines of 31, and liquid fuels of 13 papers. The remainder are devoted for the most part to such questions as economics, standardisation, education, &c. The greatest individual contributor of papers is the United States, with 63. Germany runs a close second with 59, followed not too far off by Great Britain, with 46. Austria is responsible for 38, Italy for 28, and France and Russia for 25 each, no other country having more than 17 to its credit, a number attained both by Switzerland and Czechoslovakia. No country covers a wider range of subjects than Great Britain. Of the 46 British papers, 11 are concerned with gaseous fuels, these making one-third of all the papers received on this subject. Steam power and electricity account for 8 each, internal combustion engines for 6, solid fuels for 4, and liquid fuels for 3. Roughly, it may be said that Great Britain contributed 11·5 per cent. of the total papers, her individual contributions being 11·5 per cent. of the papers on solid fuels, 23·0 per cent. of the papers on liquid fuels, 33·0 per cent. on gaseous fuels, 11 per cent. on steam power, 20 per cent. on internal combustion engines, 2 per cent. on water power, 43 per cent. on mechanical transmission of power, 5·3 per cent. on electricity, 9 per cent. on power economics, 16 per cent. on standardisation, and 22 per cent. on education. These figures, if they can be taken as any indication at all of the relative position of Great Britain to the rest of the world, with regard to developments in these respective branches of engineering, are a little surprising. To those who do not realise the extent of the progress which this country has made with regard to internal combustion engineering, it will come as a salutary shock to note that British authors have contributed relatively twice as much information to the Conference on such engines as on steam engines, and have indeed presented one-third of all the papers received on the subject. In the matter of fuels of all kinds British authors are also well to the fore, contributing three papers on this subject, or more than any other nation, including the great oil-producing countries of the world.

(To be continued.)

Domestic Heat Supply.

THE lecture given by Mr. A. H. Barker, M. Inst. C.E., at the Joint Gas Conference in Birmingham in February last, contains an account of a series of experiments and observations extending over five years, on the operation of an elaborate plant in the lecturer's private house, which was specially designed by himself for the purposes of these comparative tests.

An explanation is given of the great difficulty of making such tests in such a way that the results can have any general application. If such tests are made in a scientific manner the processes are so different from those employed by a cook that the results have little practical application, except comparative ones. On the other hand, if they are made in the practical manner, by using the plant as it is used in ordinary service, the results are liable to vary very widely, through accidental and special circumstances, or on account of personal differences between the operators.

In order to secure reliable averages it is necessary to change over frequently from one kind of plant to another, and operate each for a considerable period.

In order that this might be possible the house was supplied with three or four completely different sets of domestic appliances, each being in itself complete and adequate for the use of the entire house. The house is equipped with complete central heating, coal, gas and electric fire equipment in every room, with hot water service which can be supplied either with coke, oil, gas, or electricity, with cooking appliances either by solid fuel, gas, or electricity, and refrigerator plant which can be operated either by gas or electricity. The same inhabitants and staff have been in charge of the appliances throughout the whole period of the test, which extended over a period of five years. Hence, the results have a degree of uniformity which is rarely obtainable.

The tests were carried out on the basis that, while reasonable economy was to be observed in operating the various sections of the plant, no undue parsimony which would not have been exercised in practical life was to be attempted. All plant was to be carefully used in the ordinary way, and arrangements were made to take the readings of the numerous meters. The figures so obtained were afterwards analysed and the results are set out in a series of nineteen tables and diagrams, showing the rate of consumption and the relative cost.

The general results are as follows:—

Heating.—It was shown that gas boilers can only be employed for such purposes as central heating and the supply of hot water in a circulating system, at a cost, in gas, of about 3·7 times the cost of solid fuel. That the general use of coal fires to produce the same results as are obtained by a good system of central heating, costs 2·7 times as much as when coke is burnt in the boilers. That gas fires in a continuously used room cost about 2·2 times as much as the corresponding coal fires, while in an occasionally used room the actual cost is less than coal fires, depending on the degree of use. The electric fires in the same conditions are found to cost from 1·57 to 1·98 times as much as the gas fires. Details are given of the use of the rooms to which these figures apply. The point is emphasised that the economy, or otherwise, of gas and electric fires can only be secured by careful regulation. It is explained, however, that the cost of fuel is by no means the only cost of a fire, and it is shown that the whole cost of a gas fire is not notably greater than that of a coal fire, even in a constantly used room. Comparisons are made between the use of gas and electric fires and the conclusion is drawn that, for the purpose of this establishment, the most generally economical and satisfactory results were obtained with a gas fire of a "Cinderella" type.

Hot Water Supply.—Figures are given of the relative cost of gas, coke and electricity for the production of hot water. Details are given of the plant in the house and of the cost of running.

Cookery.—Similar results are given of the relative cost of cooking by gas and by electricity, the plant being tested both in the laboratory manner, by the preparation of isolated meals, and by doing the cooking of the household successively for long periods, by gas and by electricity. A series of tables of comparative cost are given, from which it is shown that the general cost of cooking by electricity is about double that of cooking by gas, the cost of the fuel being standardised at 10d. per therm for gas and 1d. per unit of electricity. Critical comparisons are also made between these two methods, and a table showing the respective equivalents of solid fuel, gas and electricity for the various purposes in a household is given.

The concluding passages of the lecture, which is now issued by the British Commercial Gas Association, 28, Grosvenor-gardens, S.W. 1, in pamphlet form, run as follows.

Such, in outline, are the impressions made upon my mind by this prolonged and difficult, but very interesting, series of trials. I cannot dignify them by the name of "tests." The results emphasise more than ever, in my mind, what I have always believed, that electricity and gas ought not to be regarded as rivals in the service of the public, but as complementary to one another. There are, quite unquestionably, spheres where any impartial person cannot fail to see that electricity is superior to gas. There are equally spheres where to substitute electricity for gas is not only a waste of the consumer's money, but also of the fuel resources of the nation. Yet others where the substitution of either gas or electricity for coke is a plain extravagance in both respects.

I am looking forward to the time when there shall not be a separate electricity supply authority and a gas supply undertaking and coke merchant in one area, but that all shall be parts of the same amalgamated company, and that all members of the staff shall be equally trained in the proper use of all, that the waste and spare products of the gasworks shall be used to generate the electric supply, and that all the resources of the company shall be combined not only to make a profit for the shareholders, but to serve the customer with cheap gas, cheap electricity and cheap coke, all of which should be carried to every house. We hear much in these days about the advantages of what is called rationalisation of industry. I venture to say that there is no single example in the whole of industry where the advantages of that process would be so conspicuous as in this.

The Foundrymen's Convention at Middlesbrough.

No. I.

THE Institute of British Foundrymen held its annual convention in Middlesbrough this week—from Tuesday to Friday, June 17th to 20th—under the presidency of Mr. Fred. P. Wilson, J.P., of Messrs. Pease and Partners, and at the invitation of the Middlesbrough Branch, which latter was established only four years ago but which has made great progress, as is evidenced by the excellent programme it provided for the instruction and entertainment of those attending. This is the second occasion on which the Institute has held its annual meetings in Middlesbrough—the former occasion being in 1906—and it will be realised that the district, associated as it is with iron, steel and coke production, has much of interest to offer foundrymen.

The conventions of the Institute have taken their place for many years now among the meetings of the various scientific and technical societies, and are becoming of increasing importance. The international aspect of the Institute's work is one to which it has devoted a great deal of interest, and it is co-operating closely with allied bodies abroad. This is reflected in the fact that last year it entertained very many foundrymen from other countries at an international convention in London, and also in its scheme for the exchange of technical and scientific papers with foundrymen's organisations abroad. This year there are papers from America, France and Belgium, in addition to those by British foundrymen, dealing with various foundry problems.

Among the works visited by the members of the Institute in the Middlesbrough district were those of Dorman, Long and Co., Ltd., Smith's Dock Company, Ltd., Head, Wrightson and Co., Ltd., Richardsons, Westgarth and Co., Ltd., and Imperial Chemical Industries, Ltd.

Appropriately, the meetings were held in the Constantine Technical College, Middlesbrough, which has been provided through the generosity of the late Mr. Joseph Constantine and family, and is to be opened officially in the near future by the Prince of Wales. Dr. D. H. Ingall is the Principal. The general lay-out of the College has been arranged to meet the requirements of the main industries of the district, special provision being made for metallurgy, engineering and chemistry. The accommodation includes, among other things, four engineering laboratories, comprising electrical laboratory, materials testing laboratory, machine tools shop and heat and hydraulics laboratory. There are also two heavy metallurgy laboratories, one of which is an experimental foundry, whilst the other contains an experimental 10in. by 18in. rolling mill geared for both hot and cold rolling, and the College is unique in the whole world with regard to this equipment. The tuition offered at the College caters for those requiring full-time day courses as well as those requiring part-time courses. Commencing in September a special full-time day course for the foundry industry is being initiated and there is also an evening course.

The visitors to the convention were given a hearty welcome on Wednesday morning by the Mayor of Middlesbrough—Alderman Thos. J. Kedward.

PRESIDENTIAL ADDRESS.

Special reference was made by Mr. Wilson in his Presidential Address to the educational facilities afforded at the Constantine College, and he congratulated the Principal of the College on having instituted, in the first year, an evening foundry course to include periodical visits to works, and on having appointed an advisory committee of local foundry managers in connection with the course. An advisory committee had also been set up in connection with the full-day course, to which committee the Institute of British Foundrymen has been asked to appoint two representatives. The day course covers a period of two years.

As a natural outcome of such special training, said the President, the institution of a national certificate which the students of the colleges could take, and which would be recognised by employers as evidence of a definite standard of attainment would have to be envisaged. Until such a national certificate was in being, local certificates should have some value amongst employers who would take the trouble to examine the curricula.

Discussing the activities of the Institute, the President referred to the scheme which is being evolved for setting up special committees to investigate foundry problems as they arise. Good work had been done in the past by the Institute's Test Bar Committee, and it was felt that such work should be extended and that the Council should have power to set up appropriate committees, which could co-opt specialists where necessary for the exploration of matters of importance to the industry. The proposal, he said, was that a technical committee be formed to initiate investigations, tests and researches and, when necessary, to delegate inquiries to sub-committees. The President added that there was no suggestion of taking over the work and responsibilities of the British Cast Iron Research Association—with which body the Institute is closely and vitally connected—but no doubt the Association would be asked to co-operate.

In a reference to welfare schemes in industrial enterprises—which become more valuable as rationalisation results in the formation of larger units and so tends to remove the superman at the top further than ever from the labourer at the bottom—the President reminded the employers that though absence of profits in these bad times might result in a tendency to curtail such schemes, a great deal of voluntary work would always be done willingly by the employees, whose appreciation of what was offered them increased in direct ratio to the trust that was placed in them to manage the details.

The cordial relations existing between the Institute and foundry interests on the Continent and in America were also commented upon by the President as of great value in cementing the nations together in bonds of mutual friendship and respect. It was unthinkable, he said, that, whilst discussing foundry problems with representatives of other nations, we should at the same time be casting munitions of war in our shops.

A review of the papers presented at the convention will be given in a subsequent issue.

(To be continued.)

South African Engineering Notes.

High Railway Appointment.

MR. G. H. WHITEHOUSE has been appointed to succeed Mr. H. L. Pybus as chief civil engineer of the South African Railways. The appointment took effect from May 1st, when Mr. Whitehouse, who was at the time system manager of the Natal Railways, left for the South African Railways and Harbours Administration headquarters at Johannesburg. Mr. Whitehouse has been associated with railway work in South Africa since 1900.

Table Bay Trade.

The annual return of shipping and cargo dealt with at Table Bay Harbour during the year ended March 31st, 1930, shows that the total amount of cargo handled at the port during the year was 1,812,074 tons, an increase of 114,619 tons over the previous year. Of the total, 1,095,998 tons of cargo were landed, 700,740 tons shipped and 15,336 tons transhipped, compared with 974,934, 714,425 and 8096 tons respectively during 1928–29. Imports of bulk petrol increased from 27,876 tons to 56,791 tons. Oil fuel increased from 27,757 tons to 46,082 tons, and timber from 61,286 tons to 111,277 tons. Produce landed decreased from 59,368 tons to 15,897 tons; 2,375,396 cases of fruit, equivalent to 36,926 tons, were exported, an increase of 15,511 tons, or 914,578 cases. Maize and maize meal rose from 154,660 tons to 168,186 tons; wool from 17,949 tons to 20,658 tons, and citrus fruit from 34,403 tons to 37,953 tons.

Railway Earnings.

The trade slump which has taken place in the Union is clearly manifested in the railway earnings. For the week ended May 3rd the railway earnings totalled £426,813, a decrease of £26,041 on the corresponding week of 1929. Passenger receipts were down by £4000, goods by over £10,000 and coal by about £12,000. The average weekly earnings since the beginning of the new financial year on April 1st and up to May 3rd were £478,458, a decrease of £21,314 on the corresponding weekly average for last year. For the week ended April 26th the total earnings were more than £62,000 down on the corresponding week of 1929. Harbour earnings had averaged £26,498 since the present financial year began—a decrease of £7137 on the corresponding weekly average for last year.

East London Turning Basin.

The Union port of East London has had its facilities for docking ships greatly increased of late years. A huge ledge of rock in the fairway, which prevented steamers of a draught of over 23ft. or so entering the Buffalo River and lying alongside the wharves there, has been battered away by the continuous dropping of a solid steel rod of considerable length and diameter, so that the smaller mail steamers can now enter. There has, however, been the difficulty of turning in the river in order to come out, and that is now to be got rid of by the construction of a turning basin. The trade of the port is increasing rapidly, and it has been for years the largest exporter of wool, so far as weight is concerned. Of late years industrial development has also been proceeding. Undoubtedly, this improvement in the harbour accommodation will accelerate the rate of progress.

More Mining Ground for Leasing.

Three tenders have been received by the Government Mining Engineer in response to the announcement that the Governor-General had decided to lease the exclusive right to mine for precious metals underneath three portions of the farm Vogelstruisfontein No. 62. They will be considered by the Mining Leases Board. The total area offered for leasing comprises 1500 claims. It is understood that all three tenderers desire to lease portions of the farm, and that no tender has been received proposing to form a company to work the three portions as one concern. The farm is bounded on the east by the property of the Consolidated Main Reef Company and on the west and south by ground held by the General Mining and Finance Corporation, and it contains the claims worked many years ago by the old Bantjes, Vogelstruis Consolidated Deep, and other companies.

Use of Tractors.

During the past five years tractors have been more and more made use of for the conveyance of agricultural produce, particularly grain; also other goods. The rapidity of the increase is shown by the fact that in 1924 only 167 were imported, while in the four following years the figures were 199, 230, 481, and 1309 respectively, and in 1929 2696.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

COAL MINING IN THE RUHR.

SIR,—My attention has been drawn to an article in your issue of May 16th *re* the "Continental Coal Trade" on page 542 of that number.

It states "the coal output in the Ruhr has been increased by an augmentation of working hours." This conveys a somewhat controversial, and certainly most erroneous, impression. The output per man per shift worked, which is the basis on which the stability of coal production costs depends entirely, was some 18 cwt. in 1913–14 for an 8½ hours' working shift, as against over 26 cwt. to-day for a shift of 8 hours, or ½ an hour *less* than that worked in 1913. The Ruhr output was got, or produced, by machine mining to the extent of only 2 per cent., whereas to-day it is over 90 per cent.

The whole position is fully reviewed in my book on the "Economics of the Coal Industry," just published. It may be stated quite definitely that it is a retrograde step, an uneconomic and undesirable process to attempt to lessen costs of production by increasing hours of work or lowering wages. That the mining industry in the Ruhr fully realises this point may be emphasised when stating the fact that the output per man of coal per shift worked has increased about 42 per cent.—1929, compared with 1913—whereas in this country we show an improvement of nearly 5 per cent. for a working shift about 30 minutes longer than that worked in the Ruhr.

The output of the Ruhr miner was some 2 cwt. per man per shift behind that of the British miner in 1913–14, whereas to-day it is about 5 cwt. in front.

Swansea. R. C. SMART.

SIXTY YEARS AGO.

IT is perhaps a little difficult to believe, but it is none the less true, that the important position which Japan now occupies as an industrial nation and as a world Power has been reached entirely within the past sixty years. In 1870 the country had a population of over 50 millions, but it did not possess a single railway and had only just begun to use its first telegraph line. Up to 1868 the system of government was wholly and completely of the feudal type. The power of the Mikado was almost entirely nominal, the real rulers of the people's destinies and fortunes being the military nobles, or *samurai*. In that year a revolution took place, which, after some fighting, resulted in the breaking up of the old system and the restoration to the Mikado of the powers of which the nobles had gradually deprived him. Following the revolution, the Japanese at once turned their attention to the development of their country. They took the leading European States as their examples, and urged their Government, in the first place, to establish a system of railways. From some particulars given in our issue of June 24th, 1870, we learn that at that date the state of communications in the country was such that a month's travelling might be required to pass from one province to another—four or five hundred miles distant—and that the old capital Kioto was a fortnight's journey from the new capital Yedo, to which the Mikado had moved after the revolution. Yedo is now known as Tokio. The difference of language and manners between the eastern and western provinces was so great that the districts resembled different countries. One part of the country might be starving for want of the rice which another part had in abundance, while its produce of silk was lying idle for want of means of exportation. The energy of the inhabitants was being throttled, and the national debt was increasing alarmingly. All these troubles, it was believed, would be cured by the introduction of railways. The Government lent a willing ear to the suggestion, but it found itself hampered by want of funds. A loan of £1,000,000 was, however, arranged in London, and at the time at which we wrote plans had been drawn up for the construction, as a beginning, of three lines, one from Yedo to Osaka, another from Yedo to Yokohama, and a third from Osaka to Kiota and Tsuruga. Mr. G. P. White, an Indian Government officer, had been appointed consulting engineer for the work, and Mr. E. Morel and three surveyors were already at work on the routes. Some of the inhabitants were disposed to argue that the railways would deprive a large number of boatmen, chair bearers, and horse-boys of their occupation, but we expressed the view that these classes would soon find that there were more ways than one of earning a living, and that the construction of the railways would increase trade and the demand for labour. In addition to railways, the construction of telegraphs was being strongly advocated. One line laid by Mr. Brunton between Yedo and Yokohama was already in active service, and was being extended to Osaka. Many Japanese had foretold that the line would be a failure, because the populace, associating it with necromancy or Christian propaganda, would cut the wires. Actually the only damage that had been done so far to it had consisted of the hacking of some of the posts.

The Propelling Machinery of the North German Lloyd Liner Bremen.

No. II.*

In our first article we described the general lay-out of the propelling and auxiliary machinery of the "Bremen," and gave some particulars of her turbines and boilers. By the courtesy of Director Dip.-Ing. Koch, of the North German Lloyd Company, and Dr. Ing. E. Foerster, Editor of *Werft-Reederei Hafen*, we are able to reproduce in Figs. 11 and 12 on page 688 two views of one of the turbine units taken during construction and on the test bed at the builders' works. In Fig. 5 we show one of the low-pressure turbine rotors on the dynamic balancing machine,

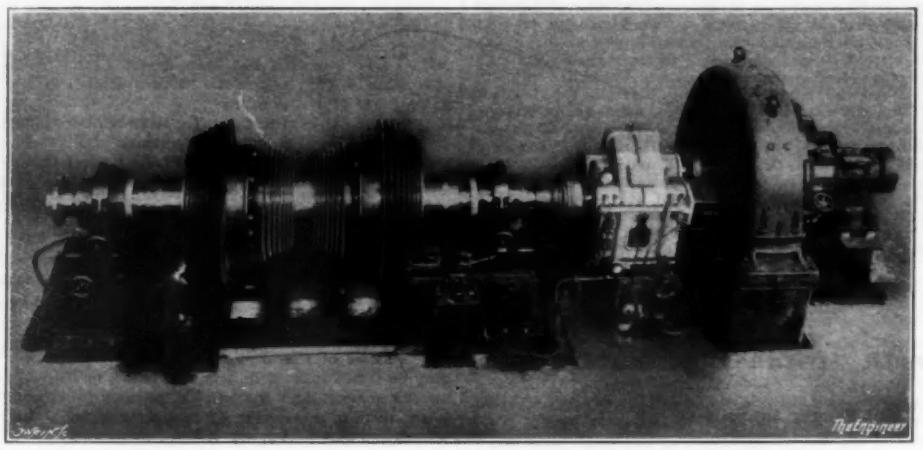


FIG. 5—LOW-PRESSURE TURBINE ROTOR ON DYNAMIC BALANCING MACHINE

while in Figs. 6 and 7 are given a typical view, taken in a boiler-room of the ship, and one of the starting platforms. In what follows we deal principally with the engine-room auxiliary machinery.

MAIN AND AUXILIARY CONDENSING PLANT.

The main surface condensers—see Fig. 8—have circular shells with top steam inlets and they are of the single-pass type. The cooling surface of each condenser is 1760 square metres and, in the case of the two outer turbines, the condensers are placed athwartships, while for the two inner turbines they are arranged parallel with the turbine axes. The general arrangement of the condensers and the auxiliary pumps was clearly shown on the machinery plan reproduced on page 608 of our issue of May 30th. In order to allow the condenser shell and steam inlet and other connections to expand, and take up their own positions, the mild steel shells are supported on riveted feet attached to the sides of the condenser. The tube plates are of Muntz metal, and special tubes are arranged in the lower part of the steam space for air cooling purposes. Provision is also made to control the flow of cooling water in the upper and lower halves separately. The condensate and also the drainage from the main turbine are dealt with by two vertical condensate pumps, which are driven by three-stage Curtis turbines. The lower pump deals with the turbine drain water, while the upper pump, which is on a level with the condenser outlet, deals solely with the condensate. The air is dealt with by four sets of steam-ejector air pumps which serve the four main turbine groups. Each set comprises two double-stage ejectors, one of which is a reserve unit, and the ejectors are directly attached to an intermediate condenser and also to a feed heater, through which the main condensate passes in series. The condensate from the intermediate condensers of the air pumps passes into the main condenser, while that from the feed heater passes to the main feed collecting tank in the forward turbine room. This tank is elevated and it supplies the main feed pumps under a small working head.

The main circulating pumps are of the horizontal single-stage, centrifugal type, and they are driven by geared turbines. Fig. 9 shows a view of one of the four groups of circulating pumps. The designed duty of each pump is 6000 to 7000 cubic metres per hour delivered against a total head of 6 m. The pumps run at 400 revolutions per minute, and the power required to drive them is 200 B.H.P. A double-flow turbine is used so that the axial thrust is avoided, and, as will be seen from the accompanying illustration, there are split casings so that provision is made for examining both the turbines and pumps without having to break the connections to the condensers.

The auxiliary condenser for harbour use has a surface of 165 square metres, and its circulating pump is engine-driven along with a wet air pump of the Simplex type.

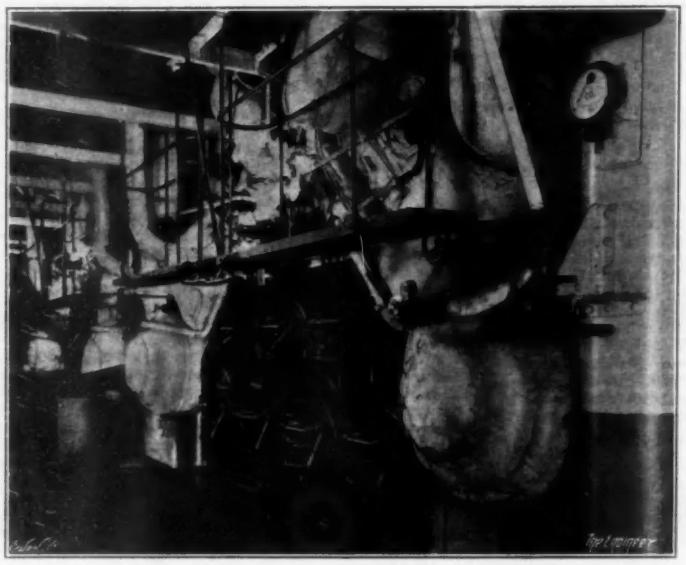


FIG. 6—VIEW IN A BOILER ROOM

FIG 7.—ONE OF THE STARTING PLATFORMS

LUBRICATING ARRANGEMENTS.

The lubricating oil equipment is divided into four groups, one for each of the four main turbine units. Each group comprises an elevated tank, a collecting tank, a filter, an oil cooler, and an oil pump, with the necessary connecting pipes, while attached to each group there is an electrically-driven oil separator for the continuous renovation of the oil circulating in the closed system.

From the elevated tank in the turbine-room hatch, the oil flows by gravity to the various parts of the turbine gearing and thrust blocks and is collected again in the double-bottom tanks. The pumps draw the oil from the collecting tank through the filters and deliver it to the elevated tank, a by-pass between the two tanks being arranged to deal with any surplus oil delivered by the pumps. Visible-flow indicator and automatic alarms are included in the lubricating system and are designed to give immediate indication of any irregular flow. Special thermometers are also arranged at the more important points on the turbine and gearing bearings. The main oil pumps are of the turbine-driven vertical type and they run at 3000 r.p.m., while the stand-by oil pumps are of the Duplex steam-driven pattern. The centrifugal oil separators each have a designed duty of some 2800 litres of oil per hour, the actual duty varying with the viscosity and the state of the oil treated. About 40 tons of lubricating oil is in constant circulation in each of the four main turbine sets, and each of the turbo-oil pumps can deal with as much as 270 tons per hour.

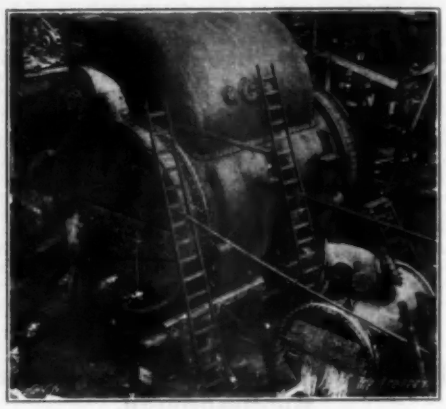


FIG. 8—CONDENSERS

BOILER FEED ARRANGEMENTS.

The main boiler feed pumps are of the horizontal two-stage, turbine-driven, centrifugal type, each pump being arranged with its turbine and its own lubricating oil service on a common bed-plate. In all there are eight feed pumps, each with a designed output of 95 to 175 cubic metres per hour against a head of 320 m. They are arranged in two groups of four on the port and starboard sides of the ship. One pump is designed to serve each of the four groups of boilers, while the other pump serves as a reserve unit. The turbines driving the pumps are of the two-stage Curtis type and a differential pressure regulator, arranged in the steam line, so adjusts the supply of steam that the pumps may maintain in the feed supply pipe a pressure greater than that of the boilers. The pumps are of the balanced two-stage type and means are provided for adjusting the end clearance of the impellers. A rotating finger enables the revolutions of the pump to be noted from the floor level, while an automatic shut-off valve, which is actuated by a diaphragm control placed in the feed line is also provided. For auxiliary service, there are ten steam-driven Simplex pumps, which are placed in the boiler-rooms and each has a designed output of 45 to 116 cubic metres per hour. In the feed connections for each group of boilers there are included two feed heaters arranged in series, the first, in the turbine-room, is supplied with heating steam from the evaporators and raises the temperature of the feed to about 90 deg. Cent. In the second feed heater, which is supplied with exhaust steam from the auxiliaries, the temperature is further increased to

* No. I. appeared May 30th.

about 130 deg. Cent. In each pump circuit there is a recording meter of the Venturi type.

EVAPORATORS AND AUXILIARY PUMPS.

There are four sets of evaporators, each of which is designed to use fresh water, and has a daily output of from 75 to 85 tons. They are arranged in two groups and are of the horizontal pattern. The casings are of mild steel and there are two heating elements, each consisting of 17 coils which are easily removed for examination and for cleaning. For drying the vapour, there is a steam dome with filter elements and "Raschig" rings. The incoming water is

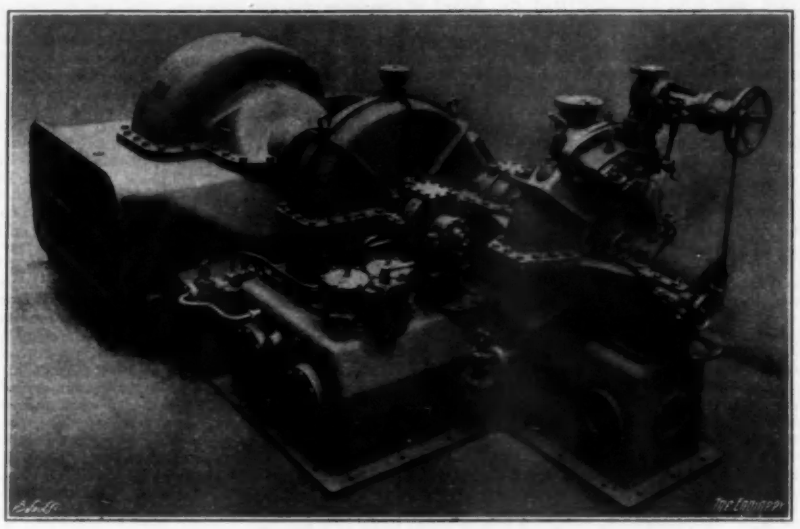


FIG. 9—ONE OF THE CIRCULATING PUMPS

de-aerated in a mixing feed heater attached to the main evaporator, and connected with it on the steam and water sides. In this heater, the feed is raised to evaporating temperature and the air released.

When at sea, the evaporators are supplied with exhaust steam from the turbines driving the circulating pumps, and in case salt water instead of fresh has to be employed, there is a supply of live steam available at the reduced pressure of 2·5 atmospheres. The supply of feed is regulated by an overhead float tank, which is filled by the fresh water pumps in the boiler-rooms. As before mentioned, the vapour passes to the feed heaters.

Other auxiliaries and pumps include: (*a*) Three vertical Simplex steam pumps for drinking water, each with a designed duty of 75 cubic metres per hour; (*b*) four vertical turbine-driven sanitary pumps, each of 200 cubic metres per hour capacity; (*c*) two vertical Duplex steam pumps for deck washing, also of 200 cubic metres capacity, and (*d*) two Duplex steam ballast pumps, each of 250 cubic metres per hour output. There are also two vertical two-stage air compressors for boiler cleaning and workshop tools, two "Turbulo" oil separators for bilge water, each designed to deal with 150 tons per hour, and circulating and filling pumps for the swimming bath; also an aerating and heating installation for the same purpose.

In the description of the boilers given in our last article, we made special reference to the arrangement of the superheater elements between the water-tube nests of the boiler. In Fig. 10 we show a view of some of the superheater elements arranged in their supporting frames.

AUXILIARY AND EMERGENCY GENERATOR SETS.

The four auxiliary generator sets, particulars of which were given in our last article, are arranged in a special engine-room aft of the second turbine-room. Each unit comprises a six-cylinder airless-injection, four-stroke, single-acting Weser-M.A.N. motor driving a 520 kW, 230-volt generator at 260 r.p.m. Each unit is complete with its own fuel, lubricating and cooling arrangements. The emergency generator sets are two M.A.N. motors of the same type, with a total output of 200 kW, and they are placed in a special compartment on one of the upper decks behind the after funnel. The installation is designed to supply light and power to all important parts of the ship should the main auxiliary plant fail.

REFRIGERATING AND FIRE-EXTINGUISHING PLANTS.

The refrigerating installation is of the Linde CO_2 type and was supplied by the Atlas-Werke. It consists of two twin double-acting compressors, which are steam engine-driven, along with the condensers, brine pumps and brine-mixing and cooling plant. The brine pumps are electrically-operated, and there are also two reserve brine pumps, which are steam-driven. The pumps are of the high-lift type, and are designed to pump the Chlorcalcium brine through brine pipes running practically the whole length of the ship and to the top sun deck some 32 m. above engine-room floor level. In the refrigerating machinery compartment, there are special indicators which notify the attendant on duty when cooling room doors are open and closed, while an extensive equipment of distant-reading thermometers also forms part of the installation.

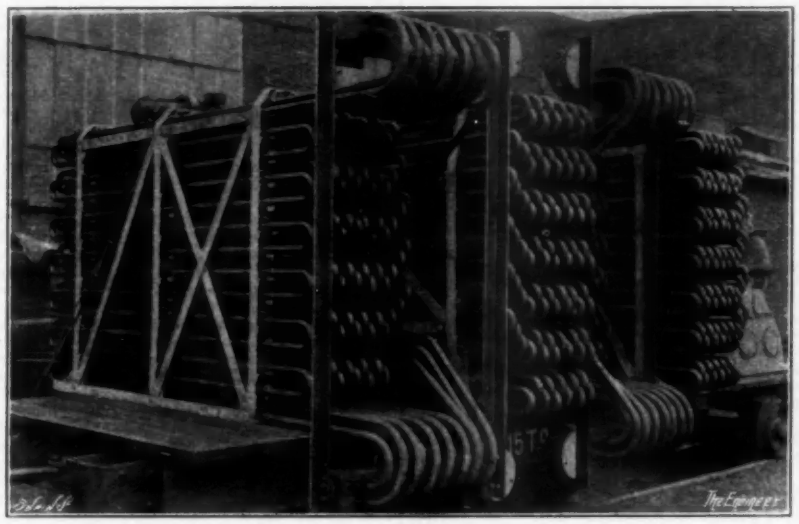


FIG. 10—SUPERHEATER ELEMENTS IN SUPPORTING FRAMES

In view of the great cost of the ship and her machinery, a very complete fire-extinguishing equipment has been provided. For the engine and boiler-rooms, there are four foam-generating plants and a large CO_2 fire-extinguishing plant, which is designed to serve both the auxiliary engine-room and the main machinery spaces. A large number of hand extinguishers are also fitted in important alley-ways and compartments. The main fire pump is a vertical three-cylinder unit with a designed output of 270 cubic metres per hour, but arrangements are made whereby the deck-washing pumps, sanitary and bath pumps can all be coupled to the fire-extinguishing system, giving an output of 1250 cubic metres of water per hour.

SERVICE RESULTS.

The liner "Bremen" has now made a considerable number of Atlantic runs since her record-making trip of July, 1929, which earned for her, along with her lately completed sister ship the "Europa," the Blue Ribbon of the Atlantic. We are able to state that the propelling machinery and the boilers have operated throughout with the greatest satisfaction to the owners, and that the reliability of the plants has been proved. The fuel consumption, we understand, is remarkably good. While the builders of the "Bremen" and the technical staff of the North German Lloyd Company deserve the greatest credit for the excellency of the machinery design and its reliability in service, mention must be made of the very great care which has been exercised in the running of the plant by the members of the engineering staff, who were specially trained at the builders' works. In all, there are thirty-six engineers in charge of the propelling and auxiliary machinery.

In concluding this article, we would express our indebtedness to the Editors of our two contemporary German technical journals—*Zeitschrift des Vereines Deutscher Ingenieure* and *Werft-Reederei-Hafen*—for placing at our disposal drawings and particulars, and to Director Koch, who permitted us, personally, to inspect the machinery installations of the "Bremen" and Europa" under service conditions and to observe for ourselves the smooth running of the machinery installations.

Report of the Departmental Committee on Area Gas Supply.*

THE necessity for the supply of gas over long distances arose first in America, where the exploitation of oilfields released large quantities of natural gas for domestic and industrial consumption. European countries, less fortunate in regard to natural sources of oil, developed their coal deposits and the production of coke. The gas thereby produced was at first almost completely absorbed for heating ovens and in auxiliary plant, but with the improved efficiency of the ovens, surplus gas became available for distribution.

At the beginning the supply of gas from this source had no more than a local character, but soon a wider field had to be found and long-distance distribution developed, notably in Germany, where the concentration of the coal mining and heavy industry in the Ruhr offered a favourable basis for schemes of long-distance gas distribution. The post-war reconstruction and rationalisation of the Ruhr industry provided an impetus to further progress in this direction. Other continental countries followed the example, although natural conditions imposed certain handicaps and limited the magnitude of operations.

The Appointment of the Gas Area Committee.—The developments on the Continent prompted the National Fuel and Power Committee to recommend, in its report of September 4th, 1928, that "the possibility of developing a system of gas mains in industrial areas near the coal-fields [in this country]" should be investigated by the Government. It was suggested that in the survey to be undertaken, the Committee should also consider "the disposal of coke," "the location of coke oven plant with respect to iron and steel works" and "the existing and potential consumption of coke, whether for the iron and steel industries or for domestic purposes." Acting on the advice of the National Fuel and Power Committee, the Board of Trade appointed the Area Gas Supply Committee on January 2nd, 1929.

The Committee has now presented its report, a work which has been prepared with great thoroughness and which constitutes a standard work of reference on account of statistics and technical data contained in it.

The iron and steel, coal and gas industries were represented on the Committee, which consisted of: Sir Alexander Walker, K.B.E., Chairman; Mr. T. Hardie, M. Inst. C.E.; Dr. C. H. Lander, C.B.E.; Mr. W. A. Lee, C.B.E.; Mr. M. Mannaberg, whose place after his death was taken by Mr. J. Henderson; Sir Richard A. Pease; Mr. S. Tagg, M. Inst. C.E. The secretariat was in the hands of Mr. R. J. Moffat, M.B.E., and Mr. D. Haigh, Dr. E. W. Smith—Technical Director of the Woodhall-Duckham Companies—acted as Honorary Technical Advisor; Dr. G. W. Anderson, F.I.C., was responsible for the preparation of a large part of the detailed technical work connected with the report, and was assisted, for some time, by Mr. F. S. Townend.

Long-distance Transmission of Coke Oven Gas in Europe.—From the survey made in regard to distance gas supply in European countries, it is evident that the use of coke oven gas for domestic and industrial purposes has been developed in Germany to a far greater extent than in any other country. About one-third of the total gas consumption in Germany is supplied from coke ovens situated in the Ruhr district and is distributed through a network consisting of many hundred miles of mains. Apart from the Ruhr district, other distribution centres are found in Central Germany, Saxony and Silesia.

Gas distribution schemes are in existence, or in the course of preparation in France, Belgium and Holland, where the magnitude of operations is considerably restricted owing to the limits imposed by the natural conditions.

Statistics of the Carbonising Industries.—It is pointed out that the conditions in Great Britain are not comparable with those in Germany. This fact was already recognised by the National Fuel and Power Committee, which, apparently, realised the futility of attempting to establish an extensive gas "grid" throughout Great Britain, and, therefore, recommended that the investigations of the Gas Area Supply Committee should be confined to an area lying between the Humber and Liverpool, and between Leeds and Birmingham. This area covers the following counties:—Lancaster, York (East and West Ridings),

* H.M. Stationery Office, London. 1930. 3s. net.

Chester, Derby, Nottingham, Lincoln, Stafford, Leicester and Warwick. The area embraces approximately 14,300 square miles, over which the gas undertakings are scattered, whilst coke ovens are more localised. On the basis of carbonising capacity, 75 per cent. are concentrated in a belt of country about 950 square miles in extent, lying between Burnley and Leeds, Wigan and Sheffield. About 35 per cent. of the coke ovens are placed within the circle of about 7 miles radius, embracing Sheffield, Rotherham and Barnsley. An additional 15 per cent. is within a circle of 10 miles, and it covers Leeds, Bradford, Halifax, Huddersfield and Wakefield.

The coke ovens in the district number 4267, of which 667 are beehive and 1632 waste heat ovens. The total quantity of coal carbonised in 1928 reached nearly 6¾ million tons, representing 38·6 per cent. of the total quantity of coal used by coke ovens in Great Britain in that year.

The gas production in the area amounted to 68,683 million cubic feet of an average calorific value of 500 B.Th.U. per cubic foot. Of this quantity 44,649 million cubic feet were used for heating ovens and 15,056 million cubic feet in auxiliary plant. Of the remaining 8978 million cubic feet, 6375 million cubic feet were sold to gas and other industrial undertakings, whilst 2600 million cubic feet were available for other purposes and probably wasted. This quantity of gas represents just under 4 per cent. of the total quantity of gas made, and is entirely available in South and West Yorkshire. It is estimated that after 1930, 101,663 million cubic feet of gas will be produced in the district, of which 11,744 million cubic feet will be "available for disposal." This represents a considerable increase over the 1928 figures, notwithstanding the rise in "gas sold" from 6375 million cubic feet to 10,693 million cubic feet. The gas, which is used for heating boilers, &c., could be added if a remunerative price could be obtained. The total quantity of gas available for disposal then would amount to 36,108 million cubic feet. If the whole district were provided with modern regenerative, or combination, ovens, consuming 27 therms of gas per ton of coal for heating, an additional 10,000 million cubic feet per annum would be available. Again, by far the largest quantity of surplus gas will be available in South Yorkshire. Notwithstanding large sales of gas, it is estimated that the surplus gas will increase from 2539 million cubic feet in 1928 to 8712 million cubic feet in 1930.

There are 355 gas undertakings in the area, of which 330 are actually working. The others are purchasing gas in bulk, mostly from coke ovens. This quantity is increasing, although the gasworks have a reserve capacity of 28 per cent. to meet increases in demand for gas. In 1928, 4463 million cubic feet of coke oven gas was purchased and represented about 40 per cent. of the total gas available for disposal—111,416 million cubic feet. The quantity of gas sent out by gas undertakings amounted to nearly 103,000 million cubic feet and is expected to increase, under normal conditions, by about 3 per cent. annually.

The low-temperature carbonisation plants erected at twelve different works have an aggregate coal consumption of 278,600 tons—1930—from which 1232 million cubic feet of gas will be made. The statistics are apparently regarded as very approximate, so that the Committee does not feel inclined to take into consideration any quantities of gas resulting from this branch of the carbonising industry.

The Coke Position.—The coke production of coke oven plants, in the Committee's area, amounted to 4,786,516 tons in 1928, and is expected to increase to 6,705,000 tons in 1930. These increases will be largely disposed of to iron and steel works, which are expected to absorb 2,000,000 tons, whilst the domestic market is expected to take 153,000 tons more, representing 8 per cent. of the total increased output.

The growing production of coke oven coke is apparently regarded with apprehension by gas undertakings, which fear competition in the domestic market. Gasworks produced in 1928, 3,350,000 tons, including 15 per cent. of breeze, and only 2,582,359 tons were sold, whilst nearly ¾ million tons were used at the works for purposes other than heating retorts and in water gas plants. The latter absorbed 360,000 tons and assisted materially in regulating the coke market. It is estimated that an additional million tons of coal would have been carbonised if water gas plants had not been in action, and thereby another half-million tons of coke would have been produced for sale.

The policy of the gas undertakings, therefore, has prevented the coke market from receiving an additional 900,000 tons of coke. These facts illustrate the position of to-day's coke market and justify the fears of the gas industry. It is realised that the gas industry holds no monopoly of the coke market, and, therefore, coke oven plant owners are in a position to enter this field. The Committee, therefore, suggest that gasworks and coke oven interests should combine and co-operate in regard to the production and sale of coke, to avoid unnecessary competition, by which the consumer would not benefit in the long run.

The Position of Coke Ovens.—According to the terms of reference the position of coke ovens in regard to iron and steel works has received consideration. There are apparently two points of view in regard to the future development of the iron and steel industry. One school of thought believes that the reorganisation of the iron, steel and coke industries will be on the lines of large installations on the coast, comprising coke ovens, blast-furnaces, steel works and rolling mills. In the opinion of others these changes are not likely to occur, particularly with regard to the iron and steel industry in the Sheffield area, which produces about one-fifth of the ingot steel production of Great Britain in works without blast-furnace plants adjoining. It is held that as the trade is a high quality trade, it is not likely that any substantial portions of the existing plant will leave the present locality.

The information, which has been placed before the Committee, tends to show that the reconstruction of coking plants in the investigation area will result in the erection of central coking plants, served by several collieries at points close to those collieries, and since coking plants are only in a few cases on the same site as steel works, the disposal of the surplus gas will remain unchanged.

Disposal of Coke Oven Gas.—Gas undertakings have increased their purchase of coke oven gas and are not averse from absorbing further quantities, but resent any compulsory measures in that respect, which the proposals of both the Coke Oven Managers' Association and the National Association of Coke Oven and By-product plant owners imply. The Committee believe that, generally, a satisfactory solution will be found through negotiations between willing buyer and seller, which will work as satisfactorily in the establishment of the network, as it has before in concluding private contracts of supply between coke oven owners and gas undertakings. In cases of difficulty it is suggested that the Joint Committee of the National Gas Council and the National Association of Coke Oven and By-product Plant Owners could act as mediators, provided the latter Association included representatives of the South Yorkshire Coke Oven Owners. It is hinted that, if necessary, compulsory measures could be introduced, and it is suggested that the Board of Trade might step in when contracting parties fail to come to an agreement.

The Ownership of the Network.—In regard to ownership, the Committee has failed to come to a unanimous agreement. The South Yorkshire Coke Oven Owners have suggested that the network should be owned and operated by them, whilst the National Gas Council wished to see it in the hands of an authorised gas undertaking. As a third alternative joint ownership by gas undertakings and coke oven owners has been put forward, to which, in the opinion of the Committee, no objection could be raised if these bodies would not act as gas distributors direct to the consumer, except with the consent of the gas undertaking in the area of supply. In regard to the specific case of the South Yorkshire network, which is discussed in detail later, it has been held by some members that, in order to expedite its establishment, the network should be owned and operated by an existing gas undertaking, preferably the Sheffield Gas Company, which already has experience in the distribution of coke oven gas and caters specially for industrial consumers. Some members prefer joint ownership of gas undertakings and coke oven owners in order to protect the coke oven interests and to prevent sterilisation of the future development of the network.

Uses of Coke Oven Gas.—Consideration has been given to the uses of coke oven gas for other purposes than the replacement of town's gas. The potential outlets are (1) for power production; (2) as raw material in the chemical industry. In regard to the former, it is shown that the value of the gas would be 2·2d. per 1000 cubic feet as compared with coal at 12s. per ton, or 3·3d. per 1000 cubic feet with coal at 18s. per ton so that a sale at those prices would not be remunerative. Certain chemical processes are in operation in Germany and Belgium, which absorb appreciable quantities of coke oven gas, but the future of those processes in this country is regarded as insufficiently established to allow a definite opinion to be expressed as to their potential consumption of coke oven gas. The Committee, therefore, concludes that a new outlet must be found amongst industrial consumers, and network schemes in the area have been examined with this object in view.

Network in the Midlands.—The total gas available in the Committee's area does not justify a network from boundary to boundary of the area, and only schemes for restricted parts have been found practicable. It is not overlooked that gasworks might link up between themselves, but owing to present statutory restrictions, to which the Committee refers in considerable detail, a development in this direction is unlikely. In the absence of adequate details from individual undertakings, the Committee prefers to refrain from pronouncing an opinion in regard to such development and confines itself to networks mainly fed with coke oven gas.

Although an appreciable surplus gas will be available in Lancashire—5160 million cubic feet per annum—the scattered nature of the coke oven plants renders a network uneconomical, even for a limited area supply. It is recommended that the surplus gas be disposed of in the locality of production by direct contracts. In West Yorkshire only a small quantity of surplus gas is available at present. It could be increased, however, through the reconstruction of plants, in which case 5591 million cubic feet per annum, including the gas used under boilers at present, would be available. For the distribution of this gas a network of, at least, 77 miles of mains, involving a capital cost which would render such scheme uneconomical, would be necessary.

Conditions in South Yorkshire are favourable both in regard to the position of coke ovens, the quantity of surplus gas available and the potential consumers. In 1928, 4628 million cubic feet of surplus gas was sold, leaving 2539 million cubic feet for disposal. This figure is estimated to rise to 8712 million cubic feet in 1930. To the quantity available for disposal 7500 million cubic feet of gas, at present used under boilers may be added, making a total of 16,000 million cubic feet per annum, equal to 50 million cubic feet per day. With modern ovens it is estimated that this figure may be increased to 33,000 million cubic feet per annum, or 100 million cubic feet per day. This gas would be produced in a circle of 7 miles, including the towns of Sheffield, Barnsley and Rotherham.

Potential Consumers in South Yorkshire.—The normal development of gas undertakings is insufficient to absorb the quantities of gas which are available at coke ovens, and no justification exists for the replacement of gas made by gas undertakings, except when another outlet for coke oven gas cannot be found. Certain industries are anxious to obtain a supply of gas at a reasonable price. The steel works, mostly situated near Sheffield and Rotherham, are probably the largest potential consumers. They produce over 1 million tons of finished steel per annum, and consume 1½ million tons of coal per annum, of which 450,000 tons is used for general furnace work. It is held that this coal could be replaced advantageously by gas, whereby the thermal efficiency of the furnace would be doubled. On this basis, 13,500 million cubic feet of gas —67·5 million therms—would be required, or 45 million cubic feet per day. If the present steel manufacturers could be persuaded to convert open-hearth furnaces to gas firing, an additional 10,000 million cubic feet of gas per annum could be absorbed, making a total of 23,500 million cubic feet, or about 80 million cubic feet per day.

The Committee has been assured by representatives of the iron and steel works that the industry would absorb this quantity within eight years, if supplies could be guaranteed at a reasonable price. It is not likely that the solid fuel used under boilers can be replaced, as for that purpose the value of the gas would only be of the order of 1d. per therm. Producer gas is made at 1·14d. to 2d. per therm in the district, but in many cases the cost is considerably higher. It is believed that if gas could be sold at an average price of 2d. per therm it would be equivalent to the average price of producer gas in the district and would attract a great number of consumers, as town's gas is already sold at 2·4d. per therm for industrial purposes in great quantities.

The South Yorkshire Network.—The network has been designed to collect gas from nineteen coke ovens in the district and supply it to the steel works at Sheffield and Rotherham. Provision has been made to cater for fresh demands for gas and to enable existing gas undertakings either to take gas from the "grid" or to pump gas into it. The Committee has specified standards for the quality and purity of the gas to be supplied to the network. The trunk main starts from the Monckton plant, north of Barnsley, and at Worsborough merges in a ring main, consisting of a western half running through Tankersley and Thorncliffe, and an eastern half through Wath-upon-Dearne, Swinton, Rawmarsh and Rotherham. Both halves meet west of Tinsley Church and continue in a single line to the three gasworks at Sheffield. A second smaller ring is attached and connects Thurcroft, Dinnington, Waleswood, Beighton and Wodehouse. It is not intended to lay down the whole network at once, but to extend it as the demand for gas increases. It is also entirely independent of existing supplies and mains between coke oven plants and gas undertakings. The mains are to be of steel coated with hessian cloth and bitumen, and will follow, generally, the roads. They have been designed for an hourly carrying capacity equal to $^1/_{24}$ of the maximum day's load—80 million cubic feet—taken as $^1/_{300}$ of the annual gas consumption.

This basis of design necessitates storage at the point of consumption, for which due allowance—1d. per 1000 cubic feet—has been made in the computation of costs. The gas is to be compressed at the coking plants at the expense of the owners, whose aggregate capital outlay for compressor plants is estimated at £63,400. The capital cost of the network, which will require nearly 73¼ miles of mains, varying from 6in. to 30in. in diameter, is estimated to cost £474,500. The capital charges for distribution—14 per cent. on the capital—will amount to 1·33d. per 1000 cubic feet on the basis of 40 million cubic feet per day, the estimated consumption of the first three years, but will be reduced to 0·66d. per 1000 cubic feet when the maximum of 80 million cubic feet per day is reached.

Economic Aspects.—The economics of the proposed scheme have been considered in full detail. The value of the coke oven gas at the works has been based on the cost of replacing it by other fuels and has been assessed at 5·3d. per 1000 cubic feet for the gas used under ovens and 1·9d. per 1000 cubic feet for the gas used under boilers. The gas "bled" has no replacement value. When the cost of purification, compression, coal and gas storage, distribution and management, &c., have been added, the total cost of gas varies between 4·49d. and 10·33d. per 1000 cubic feet—0·87d. to 1·99d. per therm—figures which may appear low, but the Committee emphasises the necessity for cheap gas in industry and indicates that the values given do not represent selling prices, but are intended to show that sufficient margin for profit exists between them and the anticipated average selling price of 2d. per therm.

Matters Incidental to the Establishment of the Network.—The Committee has also considered wayleaves, rates and depreciation of mains and finance, and has made the following recommendations:—"As the laying down of the network may involve the question of wayleaves, similar powers should be given to the Board of Trade to deal with wayleaves as are given to the Ministry of Transport in connection with wayleaves for electricity undertakings. The network should be rated in a reasonable manner, and during the early years of its development, when its profit-earning capacity may be limited, the rates upon it should be purely nominal. It is a prudent requirement that the undertaking owning the network should set aside annually a sum not less than 5 per cent. of the original capital cost of the mains, as provision for depreciation, and the necessary powers should be given for this purpose. All gas sold from the network in a gas undertaking's area of supply, whether sold direct from the network or through the existing distribution systems, should be regarded as gas supplied by the gas undertaking in question. The undertaking owning the South Yorkshire network should be given the necessary powers to lay mains for the purposes of the network through the areas of supply of statutory gas undertakings in the district covered and to afford bulk supplies of gas to those undertakings. The undertaking owning the network should be enabled to supply gas to industrial consumers direct from the network, subject to the consent of the gas undertakings, in the area of supply of which such consumers are situate, safeguards against the unreasonable withholdings of such consent being provided. When gas is so supplied direct, the gas undertakings should be allowed a reasonable commission per 1000 cubic feet of gas supplied. If the South Yorkshire network is owned by the Sheffield Gas Company (1) that company should keep the network accounts separate from its ordinary accounts; (2) that gas sold from the network in bulk to gas undertakings should be credited to the network at an agreed transfer price, but in the case of gas taken into the ordinary distribution system of the Sheffield Gas Company, the transfer price should be agreed with a small Committee of representatives of the coke oven owners pumping gas into the network; (3) the annual net profit of the network should be divided in two equal parts between the Sheffield Gas Company in respect of its ownership of the network, and the coke ovens pumping gas into it, as a bonus on its selling price of coke oven gas.

Contracts between the undertaking owning the network and the coke oven owners should be for as long periods as possible, including, if necessary, provision for variations in price according to the price of coal. No grant from public funds should be made towards the capital cost of the network, but sympathetic consideration should be given to an application for assistance in respect of the scheme under Development (Loan Guarantees and Grants) Act, 1929."

Railway and Road Matters.

THE Swedish highways have once more come into their own as lines of communication. According to a report just published, the omnibus routes in Sweden show a record development and now number no less than 2100 licensed routes with a total length of over 43,750 miles, or more than four times the combined length of Sweden's entire railway mileage.

THE *Great Western Railway Magazine* for June records the virtual completion of the new buildings required for the reconstruction of Newport (Mon.) Station, work on which was started in 1923. The dining room on the first floor will seat 200 persons and has a kitchen with an exclusively gas cooking apparatus which is said to be the largest in South Wales. The main range is 10ft. 4in. long and 5ft. wide, and has four ovens and a hot-plate with twenty-eight boiling rings.

THE operating results of the Festiniog and the Welsh Highland Railways continue to be so unsatisfactory that there is a possibility of the lines being closed. The Portmadoc local authorities are very concerned over this, and say that if such an event occurred several important quarrying interests and the employment of some hundreds of men would be affected; it was even said that Portmadoc harbour would be doomed. The intervention of the Government is to be sought.

THE anticipations of Mr. G. H. Wheeler as to the future of the Somerset and Dorset Joint Railway, mentioned in this column on June 13th, have been realised. The operation of the railway is to be in the hands of the London, Midland and Scottish, which company will absorb the locomotives and rolling stock and work the line, in the matter of such equipment, as part of its general system. The engineering work, which, as we observed on the previous occasion, is based on the London and South-Western—now Southern—practices, passes into the control of the latter company.

THE recent death of a signalman on duty in a signal box near Stroud, on the Great Western Railway, prompts us to point out that such a sad incident will not lead to a collision between two trains. If the man should die after a train has left the signal-box in the rear and before it arrives at his box, the arrival or passing of the train at the latter post will not be reported to the man in the rear, and when another train has to be sent forward, that man will want to know why, and will, of course, get no answer. Should the event happen when no train is in the section, it will be discovered when the man in the rear wants to send a train, as he will get no reply to his inquiry on the block instrument: "Is the line clear?"

THE number of railway accidents which the Ministry of Transport considers it necessary to inquire into continues to be remarkably small. Last year the number was nineteen, in 1928 it was twenty, and the average for the previous ten years—*i.e.*, since the war—was nearly twenty-one. The inquiries in 1929 related to ten collisions, two buffer stop collisions, two derailments, one failure of a privately owned overbridge, two failures of couplings, one train out of control, and one case of a passenger train running into a road motor vehicle at an occupation crossing. One of the two failures of coupling related to a freight train and the train that got out of control also was a freight train, but in the remaining seventeen cases passenger trains were involved.

THE intention of the London, Midland and Scottish Railway to dispense with about 400 men employed in its various workshops was discussed in the *Railway Review*—the organ of the N.U.R.—in its issue of June 13th. It appears that short time was suggested as an alternative, but as short time is already in operation, "the extension of this principle would not meet the situation." Our contemporary proceeds to remark that for some time it has been obvious that "the unions would be faced with the position of extensive dismissals, and perhaps this is not surprising having regard to the fact that the different methods of organisation since the grouping being more clearly established, the company is able to so arrange its work as to require a lesser number of staff." The further remark is made that on the score of traffic receipts there are likely to be further dismissals.

THE report of the Indian Railway Board for the year ended March 25th, 1929, stated that during the year there had been ordered, or had been on order when the year opened, 203 broad gauge and 230 metre gauge locomotives, of which 77 of the former and 93 of the latter were put in service during the year. The 77 broad-gauge engines were not additions, but replacements, and, moreover, besides the 77 replaced, there were 182 that were scrapped as redundant. Only nine of the 93 metre-gauge engines were additional; the other 84 were replacements. The Railway Board observes that the policy of replacing older engines of low tractive effort by modern engines of higher tractive effort was continued during the year, and the average tractive effort per engine rose from 22,442 lb. for 1927–28 to 22,832 lb. for broad-gauge engines, and from 12,912 lb. to 13,479 lb. for the metre gauge.

A CORRESPONDENT writing to *The Times* recently highly commended the municipal and railway authorities of the City of New York, because of an ordinance that there must be no steam-worked trains within its confines. The origin of that piece of legislation should be put upon record. On January 8th, 1902, there was a collision in Park-avenue tunnel, in which fifteen passengers were killed. The tunnel is at the entrance to the Grand Central Station, and is two miles long. It was always full of smoke, and those of our readers who can remember it in those days will recollect that the conductor went through the train and saw that all windows were closed before it entered the tunnel. The smoke was the main cause of the collision. As the New York Central Railroad Company was about to change the working of the line to electric traction, it raised no objection to the proposal of the State Legislature. Moreover, that was then the only railway into the city; since then the Pennylvania, the Long Island tubes, and the New York Connecting Line have been built. The last-named belongs to the New York, New Haven and Hartford, which company has also running powers into the Grand Central.

Notes and Memoranda.

THE Roman Catholic Cathedral which is to be built at Liverpool is to have a dome 168ft. in diameter, and will hold a congregation of 10,000. The dome of St. Paul's is 105ft. in diameter.

A FORM of high-speed circuit breaker has been developed by the American General Electric Company, which is capable of breaking a 2,500,000-kVA circuit at 230,000 volts. The complete breaker, which is of the oil break type, measures 39ft. by 12ft. by 23ft. high and weighs 92 tons.

THE steel framework of a four-storey bakery building in New York, measuring some 100ft. by 225ft., had been completed. The derrick which had been used for erection was being dismantled, and the boom dropped. It dislodged one of the columns, and the whole fabric collapsed.

IN the annual report of the Chief Engineer, Public Health Department, Bengal, it is stated that a new development in connection with the Dacca sewerage works was the sale of effluent to neighbouring cultivators for irrigating their crops. The charge made is Rs. 6 per acre per crop—that is, three or four waterings, as required.

THE deed transferring the sum of 8,100,000 lire (£88,000) given by the Edison Company for the creation of an institution named after Volta, the famous electrician, was signed at the Palazzio Venezia, Rome, on June 6th, in the presence of Signor Mussolini. The sum is to be the nucleus of the "Alessandro Volta Foundation," which will be linked with the Italian Academy, and the object of which will be to promote annual meetings of experts to discuss the principal problems of science, physics, mathematics, letters, arts and travel, and the improvement of the organisation of scientific expeditions.

ACCORDING to the *Chemical Trade Journal and Chemical Engineer*, an Italian chemist, Professor Bartoli, is erecting plant in the Transvaal for the purpose of demonstrating his process for extracting gold from native ores. Professor Bartoli declares that his process will treat refractory ores, whether oxides or sulphides, or silicates, and will extract much more gold than has been found possible by any known system up to the present. The process is claimed to be much cheaper than treatment by the cyanide, chlorination or any other process; also, it is much simpler in its operation.

AT Ottawa, on May 23rd, Dr. E. H. Boomer, of the University of Alberta, announced an important discovery made by himself and Dr. A. K. Clark of a method by which petrol can be produced commercially from the tar sands of Northern Alberta. The first step is to extract the tar from the tar sands, and then by catalytic pressure hydrogenation with natural gas a light oil, from which petrol can be readily manufactured, is produced. A plant has been established and is now in operation on a small scale, to test the commercial possibilities of the discovery. Dr. H. M. Tory, President of the National Research Council, said that the new method held great promise and pronounced it the most significant development in this direction for several years.

WRITING in the *Canadian Engineer* on ice problems in power development, Mr. J. Murphy says: "Twenty-five years ago, after I had with the steam from a 30 H.P. boiler prevented a 3000 H.P. hydro-electric plant, which used 1667 cubic feet of water per second, from being shut down by frazil, it was very hard to find anyone who would believe what had been done. Hydraulic engineers showed that it would require the heat equivalent of nearly fifty 3000 H.P. stations to raise the temperature of the water at one such station 1 deg. Fah. without melting any ice at all. These men, of course, missed the point entirely. I knew from experience that ice would not cling to anything if the temperature of that thing were maintained above 32 deg. Fah., the freezing point of water."

IMPORTS of asphalt into the United States increased 1·2 per cent. in quantity, from 119,588 short tons in 1928 to 121,019 tons in 1929, and 10·5 per cent. in value, from 865,046 dollars in 1928 to 955,606 dollars in 1929. As in 1927 and 1928, Trinidad, Venezuela and Cuba supplied almost the entire amount. The famous Pitch Lake of Trinidad, near Brighton, was the chief source of supply. It furnished 85,038 short tons, or 53·8 per cent. of the total imports of asphalt into the United States in 1927; 51,599 tons, or 43·1 per cent. of the total imports in 1928 and 69,908 tons, or 57·8 per cent. of the total in 1929. From the well-known Asphalt Lake of Venezuela, near Guanoco, were obtained 66,254 short tons, or 41·9 per cent. of the total imports of asphalt into the United States in 1927; 53,046 tons, or 44·4 per cent. of the total imports in 1928, and 36,605 tons, or 30·3 per cent. of the total in 1929. The mines of Grahamite, near Talaren, in the Province of Camaguey, Cuba, shipped 2616 short tons, or 1·7 per cent. of the total in 1927; 12,629 tons, or 10·5 per cent. of the total imports in 1928, and 12,854 tons, or 10·6 per cent. of the total imports in 1929.

CONSIDERING the large number of waterfalls there are in Africa, states *Nature*, it is at first sight strange that the total hydro-electric power generated there scarcely amounts to the output of a first-class steam power station. When it is remembered, however, that there is little demand for power near any of the big falls, and that there are great seasonal and year-to-year variations in the flow of water, which would necessitate the construction of large and costly reservoirs, it will be seen that at present there is no great scope for commercial hydro-electric power stations. In certain parts of Africa the high evaporation from reservoirs is a serious drawback. There are water power stations at Katanga and Northern Rhodesia in connection with copper mining. In South Africa, where great commercial developments have taken place, there is an abundant supply of cheap and easily worked coal. The Witwatersrand goldfield, for example, has an excellent coalfield quite close to it. It is interesting to learn that the negotiations between the Tanganyika Government and the Power Securities Corporation for the development of the Pangani Falls have been satisfactorily concluded. The power developed at these falls is sufficient to provide the entire region of Tanganyika Territory between the Great Lakes and the Indian Ocean with electric power.

Miscellanea.

THERE are now on the Gold Coast electric light and power plants in Accra, Sekondi, Kumasi, Koforidua, and Aburi, and schemes for installations in other towns will no doubt be proceeded with when financial conditions are less stringent.

A SUCTION dredger, 150ft. long by 40ft. beam and 12ft. deep, is being built in Canada for service on the St. Lawrence. It will be driven by four 700 horse-power, eight-cylinder Diesel engines connected with 400 kW, 250-volt direct-current generators.

IN consequence of the ban placed on outboards on the Thames by the Port of London Authority, it has been found necessary to alter the venue of this year's British International Motor Boat Meeting, and it has been decided to hold the event on the Welsh Harp, Hendon, on June 26th, 27th and 28th. To afford an opportunity to Londoners who are at business during the day to witness the racing, the starting time each day has been fixed at 5.30 p.m.

THE construction of the Pykara hydro-electric scheme, recently sanctioned, is now in hand. Contracts for the construction of several masonry works have been awarded, and work is being pushed on so that something substantial may be done before the rainy season sets in. The Madras Government is now considering the question of obtaining suitable machinery, and it is proposed to send Major H. G. Howard, chief engineer for hydro-electric development, to Europe to consult leading manufacturers.

IN order to afford working welders an opportunity of bringing the results of their practical work to the notice of their fellow-members of the welding industry, the Institution of Welding Engineers is offering a prize of ten guineas and its gold medal for the best original paper by a *bona fide* operative welder. The competition will close on August 31st. The judges will be Major James Caldwell, nominated by the I.E.E., and Mr. L. St. L. Pendred, President of the Institution of Mechanical Engineers. The winning paper will be read before the Institution.

THE special report on radio research by the Department of Scientific and Industrial Research, just published by H.M. Stationery Office, price 5s. net, reviews the design of radio receiver amplifiers and includes a general bibliography of the literature of the subject, which is believed to be complete from 1916 to April, 1929. Prepared at the National Physical Laboratory on behalf of the Radio Research Board with the object of indicating the lines along which future research may be profitably undertaken, the report should be valuable to students of the subject. The review is essentially critical, bringing out the relative importance of its different sections.

IN connection with the reopening of St. Paul's Cathedral on June 25th, after seventeen years of restoration work, the Council of the Royal Institute of British Architects has, with the assistance of the Cathedral authorities, arranged in its Galleries at 9, Conduit-street, London, W. 1, an exhibition of models, masonry specimens, drawings, and photographs, to illustrate the work of restoration. This exhibition will be open, free, to the general public between the hours of 10 a.m. and 8 p.m.—Saturday, 5 p.m.—from Monday, June 23rd, to Saturday, June 28th, inclusive. The exhibition will also be open at a general meeting on Monday, June 23rd, at 8.30 p.m., when an illustrated lecture on the subject will be delivered by Captain C. Stanley Peach, F.R.I.B.A., and Mr. W. Godfrey Allen, F.R.I.B.A.

A MESSAGE from Wellington, N.Z., dated June 12th, states that the engineers at work on the repairs to the Arapuni hydro-electric plant, which has been closed owing to a fracture in the spillway, have now decided that it will be necessary to concrete the whole headrace from the main dam to the spillway, a distance of about a mile, and also to concrete the cliff face of the falls below the spillway and to construct a concrete floor at the base of the falls. The work will involve the closing of the Arapuni plant for many months. The cost will probably exceed a quarter of a million. Commenting on this statement, Mr. W. B. Taverner, Minister of Public Works and Transport, is reported to have stated that he would not come to any hasty decision in the matter, and that, as the problem presented extraordinary difficulties, he was awaiting fuller information from the experts.

A MESSAGE from Sydney states that a move has been made in New South Wales by the Automotive Manufacturers' Association towards the standardisation of qualities of spring steel. At its last meeting the Association agreed to the following resolution: "That the Standards Association be requested to initiate action towards a reduction of the number of types of steel used to comply with the various specifications of motor spring steels demanded by importers of cars and trucks; and that the Standards Association call a conference of the factory representatives for all types of cars and trucks in Australia, all the representatives of spring manufacturers, and of the steel companies for the purpose of giving the matter preliminary consideration. That, in view of the present demand being made on spring makers, we ask that this conference be called at the earliest possible date."

ON June 4th, Mr. Arthur Michael Samuel asked the Minister of Health in the House of Commons whether he would request the National Physical Laboratory and the Building Research Station to embark upon an investigation with the specific object of enabling them to advise on their own initiative Local Authorities as to how such Authorities could advantageously eliminate rules and practices from existing building regulations which did not take into adequate consideration modern improvements in building materials and methods, and are, consequently, hindering employment in the building and co-operant trades. Miss Susan Lawrence replied that the question raised was (in London) for the London County Council. Elsewhere the by-laws referred to had been in recent years subjected to a process of reconsideration with reference to modern improvements in building materials and methods, and that the Building Research Station was engaged on continuous and systematic investigation into building materials and structure.

PROPELLING MACHINERY OF THE NORTH GERMAN LLOYD LINER "BREMEN"

AKTIEN-GESELLSCHAFT "WESER," BREMEN, ENGINEERS

(*For description see page 684.*)

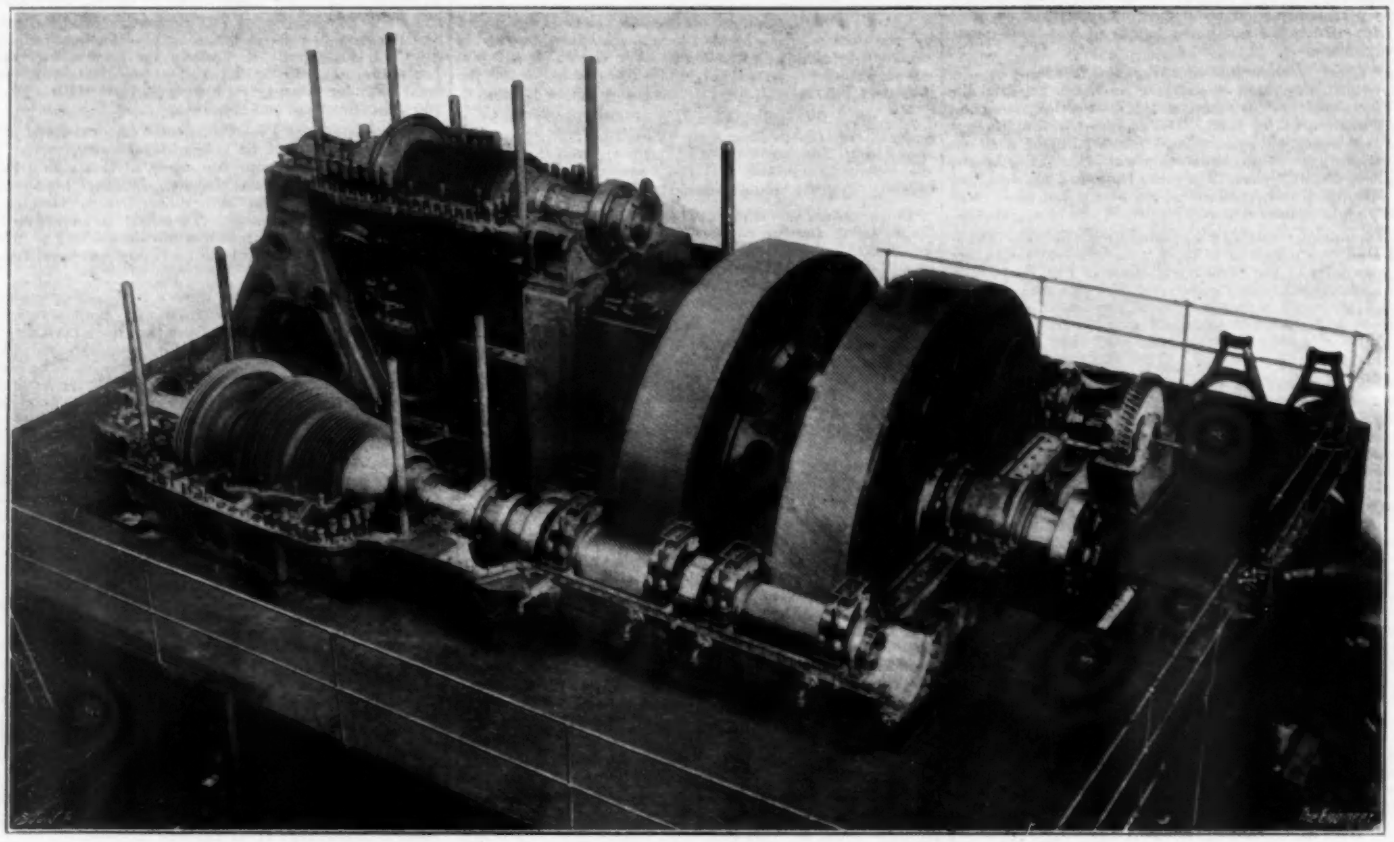


FIG. 11—ONE OF THE MAIN TURBINE UNITS AND GEARING UNDER CONSTRUCTION

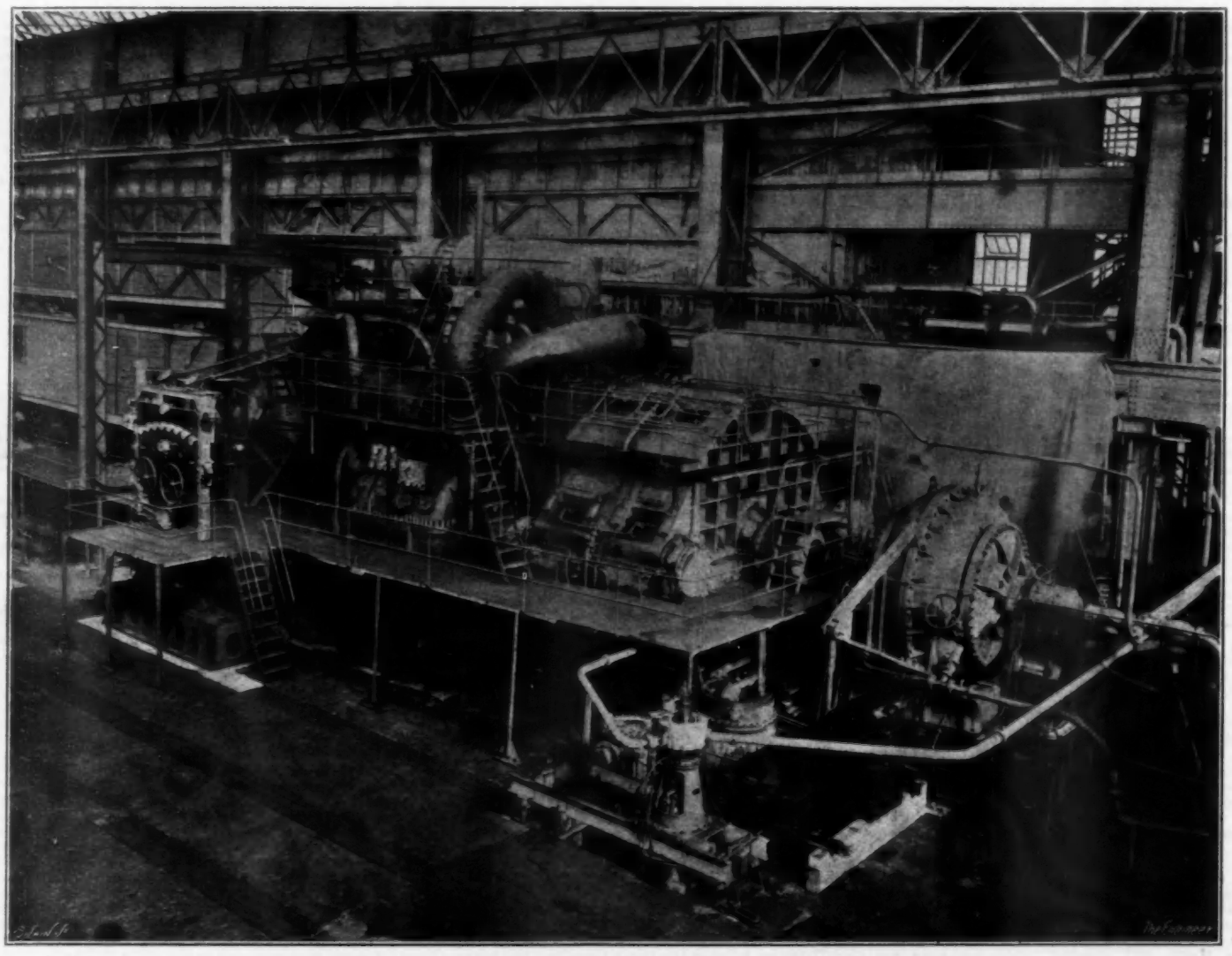


FIG. 12—TURBINE UNIT ON TEST BED AT MAKERS' WORKS

The Engineer
Annual Subscription Rates

(Including postal charges).

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below :—

BRITISH ISLES		£3	5	0	
CANADA		£3	3	0	Thick Paper edition.
		£2	18	6	Thin Paper edition.
ABROAD		£3	7	6	Thick Paper edition.
(except Canada)		£3	3	0	Thin Paper edition.

AFRICA	Central News Agency. All Branches
* £3 7s. 6d.	CAPE TOWN : Wm. Dawson and Sons, Ltd.,
† £3 3s. 0d.	29–31, Long-street (Box 489)
	JOHANNESBURG : C. Juta and Co.
ARGENTINE	BUENOS AIRES : Mitchell's Book Store, 576,
* £3 7s. 6d.	Cangallo
† £3 3s. 0d.	
AUSTRALIA	Gordon and Gotch (Australasia), Ltd. All
* £3 7s. 6d.	Branches
† £3 3s. 0d.	MELBOURNE : Robertson and Mullens,
	Elizabeth-street
BELGIUM	BRUXELLES : W. H. Smith and Son, 78–80,
* Fr. 590	Rue du Marché-aux-Herbes
† Fr. 550	
CANADA	American News Company, Ltd. All Branches
* $15·25	MONTREAL : Gordon and Gotch, Ltd., 334,
† $14·25	Notre Dame-street, W.
	TORONTO : Wm. Dawson and Sons, Ltd., 87,
	Queen-street East
	TORONTO : Gordon and Gotch, Ltd., 81,
	Queen-street West
CEYLON	COLOMBO : Wijayartna and Co.
* Rs. 44·5	
† Rs. 41·5	
CHINA	HONG KONG : Kelly and Walsh, Ltd.
* $37	SHANGHAI : Kelly and Walsh, Ltd.
† $34·5	
EGYPT	CAIRO : Express Book and Stationery Store,
* £3 7s. 6d. (Pt. 330)	9, Chareh Maghrabi
† £3 3s. 0d. (Pt. 308)	
FINLAND	HELSINGFORS : Akademiska Bokhandeln,
* M. 650	Alexandersgatan, 7
† M. 605	
FRANCE	PARIS : Boyveau and Chevillet, Rue de la
* Fr. 418	Banque, 22
† Fr. 390	PARIS : Librairie Berger-Leverault, 229, Bld.
	St. Germain
	PARIS : Brentano's, 37, Av. de l'Opera
	PARIS : Dunod, 92, Rue Bonaparte
	PARIS : W. H. Smith and Son, 248, Rue de
	Rivoli
GERMANY	BERLIN-LICHTERFELDE-WEST : H. Her-
* R. mks. 70·00	manns, Dahlemer Strasse 64 A
† R. mks. 65·00	WESTERN GERMANY : Fritz Rehfus, Blumen-
	thalstrasse 10, Cologne
	LEIPZIG : K. W. Hiersemann, Konigstrasse 29
HOLLAND	ROTTERDAM : Hector's Boekhandel, Noord-
* Fl. 41·00	blaak 59
† Fl 38·00	ROTTERDAM : Techn. Boekhandel, "Plan C,"
	Gelderscheestraat 4
INDIA	BOMBAY : Thacker and Co., Ltd.
* Rs. 45	CALCUTTA : Thacker, Spink and Co.
† Rs. 42	
ITALY	MILAN : Ulrico Hoepli
* Lire 300	ROME : Maglioni and Strini, 307, Corso
† Lire 280	ROME : Fratelli Treves, Corso Umberto I, 174
	ROME : Fratelli Bocca
	TURIN : Rosenberg and Sellier, v. Maria
	Vittoria 18, and their Branches at Naples
	and Rome
JAPAN	Maruzen Co. All Branches
* £3 7s. 6d.	
† £3 3s. 0d.	
JAMAICA	KINGSTON : Educational Supply Co.
* £3 7s. 6d.	
† £3 3s. 0d.	
NEW ZEALAND	AUCKLAND : Whitcombe and Tombs, Ltd.
* £3 7s. 6d.	Gordon and Gotch, Ltd. All Branches
† £3 3s. 0d.	NAPIER : J. Wilson Craig and Co.
RUSSIA	LENINGRAD : Mezhdunarodnaya Kniga, Pros-
* £3 7s. 6d.	pect Volodarsky, 53 A
† £3 3s. 0d.	MOSCOW : "Litisdat," Kousnetsky Most, 5-15
STRAITS SETTLEMENTS	SINGAPORE : Kelly and Walsh
* $29·25	Ltd.
† $27·25	
SWEDEN	STOCKHOLM : A/B Wennergrens Journal-
* Kr. 61·00	expedition, Stockholm 1
† Kr. 57·00	STOCKHOLM : A/B C. E. Fritzes Kungl.,
	Hofbokhandel, Fredsgatan. 2
SWITZERLAND	BERNE : Joh. William De Groot, Laupenstr. 5
* Fr. 85·20	ZURICH : Rosa Leibowicz, 4, Ankerstr.
† Fr. 79·50	
UNITED STATES OF AMERICA	International News Co., 131, Varick-street, New York, N.Y., and all Branches
* $16·40	Entered as second-class matter at the Post Office,
† $15·25	New York, N.Y., December 12th, 1896, under the Act of March 3rd, 1879 (Section 397, P.L. & R.)

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch —minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 28, Essex-street, Strand, London, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Tel.: Central 6565 (3 Lines.)

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, June 20th, 1930.

	PAGE
A SEVEN-DAY JOURNAL	675
MONTREAL HARBOUR BRIDGE. No. I. (Illus.)	676
THE TRAINING OF AN ENGINEER	678
THE INFLUENCE OF PIPE DIAMETER ON ORIFICE DISCHARGE COEFFICIENTS. (Illus.)	679
THE WORLD POWER CONFERENCE AT BERLIN. No. I.	682
DOMESTIC HEAT SUPPLY	682
THE FOUNDRYMEN'S CONVENTION AT MIDDLESBROUGH. No. I.	683
SOUTH AFRICAN ENGINEERING NOTES	683
LETTERS TO THE EDITOR—	
Coal Mining in the Ruhr	683
SIXTY YEARS AGO	683
THE PROPELLING MACHINERY OF THE NORTH GERMAN LLOYD LINER "BREMEN." No. II. (Illus.)	684
REPORT OF THE DEPARTMENTAL COMMITTEE ON AREA GAS SUPPLY	685
RAILWAY AND ROAD MATTERS	687
NOTES AND MEMORANDA	687
MISCELLANEA	687
LEADING ARTICLES—	
'Prentices and College Workshops	689
The Time for Re-designing	690
ELECTRICITY SUPPLY IN GREAT BRITAIN	690
LITERATURE	691
THE AUTOMATIC STABILISATION OF SHIPS. No. XII. (Illus.)	692
THE MILLAM FREE WHEEL AND SPRAG. (Illus.)	693
VARIABLE DENSITY TUNNEL. (Illus.)	695
INSTITUTION OF ELECTRICAL ENGINEERS' CONVERSAZIONE	695
BRITISH EMPIRE TRADE EXHIBITION, BUENOS AIRES, 1931	695
INSTITUTIONS OF ENGINEERS AND SHIPBUILDERS	695
MARINE STEAM BOILER. (Illus.)	696
CANADIAN ENGINEERING NEWS	696
DIPLOMA FOR SPECIAL LIBRARIANS	697
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	697
Lancashire	697
Sheffield	698
North of England	698
Scotland	699
Wales and Adjoining Counties	699
LAUNCHES AND TRIAL TRIPS	699
CURRENT PRICES FOR METALS AND FUELS	700
FRENCH ENGINEERING NOTES	701
BRITISH PATENT SPECIFICATIONS. (Illus.)	701
FORTHCOMING ENGAGEMENTS	702

NOTICES TO READERS.

*** *If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconveniences, if suffered, can be remedied by obtaining the paper direct from this office.*

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

THE ENGINEER.

VOL. CXLIX No. 3884

JUNE 20, 1930.

'Prentices and College Workshops.

IN the article by Professor F. W. Burstall on "The Training of an Engineer," which we print with much pleasure to-day, many interesting and debatable points are raised, and we trust that we shall have the benefit of our readers' opinions upon them. Professor Burstall lays stress upon the necessity of giving attention to the commercial aspects of mechanical engineering, and he hints that, under modern conditions, apprenticeship as a regular part of engineering training may disappear. These two things are not, as might appear at first sight, disconnected. On the one hand, if education upon the business side of engineering is to be included in the college curriculum, the course will have to be lengthened and the needed time will probably be drawn from the years now devoted to apprenticeship. On the other hand, since the business and management aspects of mechanical engineering are becoming, in the opinion of many, of greater importance than the technical aspects, the value of workshop training may diminish. Thus looked at from either side Professor Burstall's argument leads to the conclusion that apprenticeship will tend to fall into disuse and—as some knowledge of metals and methods must be obtained—that the importance of the college workshop will increase.

We trust that it is something more than our own predilection which makes us unwilling to accept this conclusion. We have always held that apprenticeship or pupilage is an absolutely essential element in the education of an engineer. Indeed, if we had to choose between an extension of the college course and workshop training we should unhesitatingly select the latter. We agree that the age at which the engineer begins to earn a salary upon which he can live is already high; in other words, the training takes too long, but we are convinced that it would be wrong to rob the workshop for the sake of the college. We know, with regret, that some employers are engaging young men straight from universities and technical schools and paying them good salaries, but we are far from doubtful about the wisdom of that plan—we have no doubt whatever that in the long run it will have an adverse effect upon the quality of engineers. At the same time we cannot be blind to the financial difficulty. It is hard to expect a young man who has succeeded with difficulty in paying his college fees to refuse a remunerative post, and so tempted, he is not likely to select apprenticeship for which he may have to pay a premium, and by which he will not earn enough to support himself. Some of our engineering firms have not been slow to see what must ultimately occur if the practice continues, and to guard against it they not only do not ask for premiums, but actually pay their pupils on a very generous scale. A notable example is afforded by W. H. Allen, Sons and Co., Ltd., of Bedford. We see from a pamphlet recently issued by this firm that for a three years' course open to well-educated men it pays its pupils two pounds per week during the first year, two pounds ten during the second, and three pounds in the third. That seems to us to indicate not only a far-seeing policy in respect to the firm itself—for obviously it will be able to select for its own appointments the best of the men so trained—but a policy of great value to the engineering industry as a whole. In the past the employer looked upon apprentices and pupils as a source of direct income. It is a much larger view to regard the giving of workshop training as a duty owed to the industry and to the country as a whole. Moreover, the democratic principles of the day are satisfied thereby. The poor but able young man is given facilities for completing his training which at one time, not so many years ago, were available only to the rich or well-to-do. If Messrs. Allen's example were generally followed one of the obstacles to apprenticeship and pupilage which Professor Burstall sees would disappear, and we should then be delivered from what he seems to regard as the inevitable alternative—the exaltation of the college workshop. It would be difficult to convince us that students ever learn much in college workshops—save, of course, in purely technological schools. For a couple of years they spend a few hours in them weekly, and they are supposed thereby to acquire some familiarity with workshop methods and materials. What they can learn of handicraft in the time allotted and under the conditions is negligible and, of course, the factory atmosphere is wholly lacking. Some sort of college workshop is, perhaps, necessary to meet the needs of the laboratories for new apparatus and general repairs, but it is probable that students would learn more by watching proper mechanics at work in such laboratories on real jobs than they do by pottering about with tools themselves. But the right thing for them is to devote a few weeks of the long vacation to the works and to miss no opportunities of visiting factories. It is said that employers will not assist pupils to enter works for a few weeks. That may have been the case in the past, but we believe that nowadays there would be relatively little difficulty in securing their co-operation if a serious scheme were worked out and pushed energetically.

For years past a gentle but insistent pressure has been directed against the necessity of workshop training for young engineers who have had a college education. It is, we think, based on an erroneous conception of mechanical engineering. The student straight from the lecture hall and the class room, possibly glorying in the honour of a recently conferred degree, believes, not unnaturally, that the practice of science and all that it connotes is the principal occupation of the engineer. In a few years he learns his mistake. He discovers that, whilst science plays an important part, it is only half the battle. Only now and then does he find that he is called upon to use precise science, though all his thoughts must be directed by the scientific method. He awakens to the fact that workshop knowledge is of more importance in the direction of a factory than most of the things that he has learnt in college. There he will have been taught very little about organisation for output and nothing about workshop methods which depend upon local conditions. In the works he will find that amongst his most important teachers are men who come round with something to sell—a new machine or a new accessory—and he will discover that the adoption of the best is limited by financial and economic considerations. He learns, too, that "hit and miss" development is the common method of progress in mechanical engineering. Above all—as Professor Burstall very properly acknowledges—he will gain acquaintance with the fact that the principal "machines" in all factories are the men themselves, from the managing director to the labourer "on the floor." These are the things that fill his life; by his understanding of them he succeeds. The subjects of his

B.Sc. examination have almost disappeared; they remain rather as an influence than as facts. The workshop instincts which he develops—if he is any good in the manufacturing branch of mechanical engineering—are all in all. They cannot be acquired anywhere else than in the works, and they are best sought for at an early age. They are as important to the designer as to the works manager, and the consultant and inventor who is unable to appreciate them is at a disadvantage. That is why we hold fast by the apprenticeship system. Possibly technical schools and universities might be made more useful to the young engineer by the introduction of the subjects which Professor Burstall, who is very familiar with the realities of the factory, suggests, but we do not believe that any amount of college education in them can ever take the place of the day-to-day touch which is given by a few years as an apprentice or pupil.

The Time for Re-designing.

"A WORKS—not large—in our own area, found their order book greatly depleted through serious competition and so-called bad times. . . . Now they find that they can compete with almost any market in the world. Their order book is overflowing and their only limitation is the productive capacity of the works. Courage, a definite policy and enterprise gained the day." We quote these words from the presidential address of Mr. G. E. Windeler to the North-Western Section of the Junior Institution of Engineers, as published in the latest monthly *Journal* of the Institution. They were uttered to convey a lesson, which, coming from so experienced and practical an engineer, ought to be taken to heart by all manufacturers. The first sentence reflects a state of affairs unhappily only too common to-day in engineering works of all sizes. The firm in question was suffering, like hundreds of others, from the widespread depression of trade, yet, without any change in external conditions, with no relief from the burden of taxation or the cost of transport, it recovered by its own efforts an enviable degree of prosperity. If this were a moral story the reader would be told that the happy end was attained by "scientific research" or "rationalisation," or "motion-study," or some other panacea of current popularity. But being merely an account of facts, we can give no such explanation. Mr. Windeler, indeed, does not make use of any of these terms in the whole course of his address, not even the word "research" finding place in his argument. How, then, it will be asked, could a small firm succeed in reviving its business and even developing an export trade while the industry generally was profoundly depressed? The answer is a simple one, almost too simple, indeed, to be acceptable to those who want to find a pot of gold at the rainbow's end rather than discover wealth by diligently digging in their own fields. Stated in all its baldness, what the firm did was merely to re-design its standard products. "In the works was a comparatively young man, capable, full of ideas, initiative and energy. He suggested that, as they were slack, they should completely revise their product. Such a policy meant temporary loss of output, costly designs and patterns, jigs, special fixtures and a considerable capital expenditure. Fortunately, the head was a far-seeing person and ultimately authorised the revision. They designed, redesigned, and designed again, using to the uttermost the ability available in the works, cutting out every nut and bolt which was not necessary and reducing thicknesses of material not required, with the result that they produced a machine which gave an increased output, simpler in design, less costly to produce, with parts strictly interchangeable and, therefore, cheap to assemble, but still retaining their high standard of workmanship." These are the words of Mr. Windeler, omitted from the quotation with which we began. Taken with their context, they tell a story which is good to hear. The spirit of the practical engineer runs through it. A serious state of affairs had to be dealt with, and it was fairly and squarely tackled with courage, self-reliance and common sense. The result fully justified the action taken and, possibly, even more than fulfilled the expectations of those responsible.

The whole incident is one which will well repay study by those who think that there is no way of relieving the troubles of many engineering firms without recourse to expedients, most of which are indirect and some of doubtful efficacy. The reform in this case came from within and could be put into effect at once. There was no waiting for any form of Government action, or for the results of what is called "research." Nor did the firm cast about to obtain licences for the manufacture of machinery to foreign designs in the hope of rehabilitating its fortunes. There was, happily, at its head, a man of judgment who trusted his staff and knew how to turn their abilities to account. All believed, no doubt, that their machinery was as good as anything of its kind on the market; but it is equally certain that most of them had a feeling, conscious or subconscious, that it could be improved in details. The pattern-shop and foundry, perhaps, would have liked fewer loose pieces on the patterns and fewer and simpler cores; the machine-shop wondered why difficult setting and machining operations were called for when a trivial modification in design would have rendered the work easy, and the erecting shop may have been worried with semi-inaccessible parts and needlessly troublesome adjustments. The drawing-office, when aware of any of these little difficulties, may reasonably have hesitated to interfere. The machines worked well, they were invested with all the sacredness of "our standard practice," and it may have seemed better to tolerate minor defects in design than to incur all the cost, trouble and confusion of rectifying drawings, patterns and jigs. How far this imaginary picture represents the firm referred to by Mr. Windeler we do not know, but it is certainly typical of the case of hundreds of engineering works. There is hardly a "standard" machine in existence, the construction of which could not be very greatly cheapened and simplified if its design were overhauled in detail and as a whole by really practical critics, as familiar with its conditions of service as with all the processes of manufacture concerned. To make little changes here and there is rarely worth while, as small alterations are always vexatious and, unless really necessary, are rarely worth the expense. Common sense supports the policy of letting well-enough alone until the time comes when something must be done. But when trade is slack, order books are nearly empty and the drawing-office has little to do, few enterprises are likely to be more remunerative than a thorough revision of designs. Thoroughness is the essence of the matter. The firm instanced by Mr. Windeler "designed, re-designed and designed again, using to the uttermost the ability available in the works," so that every promising variation was tried out on the drawing-board and every detail of manufacture discussed with the shops. Such a course could hardly fail to produce a machine almost incomparably superior from the manufacturing point of view to one possibly designed against time by one man in the first place and modified by accretions only when changes became compulsory. Full advantage could be taken of materials and workshop processes unavailable when the original design was made, while the multitude of counsellors need not prevent a harmony of the parts and an appearance of the whole, at least, as pleasing as if all details had emanated from the mind of a single designer.

Whilst the expense incurred by a fundamental revision of design may be estimated and set off against the commercial benefits to be derived, the figures will not tell the whole of the story, even though they indicate benefits as substantial as were achieved in the case referred to. What the accountant cannot show is the influence of the atmosphere created in the works as a by-product of the policy. A keen interest in the birth of a virtually new machine which everyone hopes and believes will do himself and the firm credit is naturally awakened. The intensive study of mechanical details has its repercussion in directing attention to questions of design and manufacturing generally. The co-operation of experts in particular trades with the drawing-office, which is absolutely necessary if the best results are to be obtained, broadens the outlook of all parties and makes the men in the shops realise that their knowledge and skill are valued as an asset to the firm. And with all this many of the little but irritating grievances are automatically removed. The draughtsman is happy because the machine is now as good as he can make it, and he is no longer called upon to perpetuate details of which he disapproves, for fear of altering "standard practice." The pattern-maker's job is easier because unnecessary difficulties have been eliminated; the moulder no longer fears "wasters" resulting from incompetent design, while the men in the machine shops and erecting shops are no more required to solve problems that should never be set them. These considerations may seem trivial one by one, but taken in the aggregate, their influence on the smooth running of a works is far from negligible. So it is with regard to the influence of mechanical details on the perfection of a machine. A pound saved here and a shilling there may not be large sums in themselves, but multiplied by the hundreds of details which go to the making of a machine, the total may easily represent the difference between commercial success and failure. Every penny spent on manufacturing that might be saved by better design is sheer waste, and it is not unlikely that many firms might follow with advantage the policy adopted by the one whose story was recounted by Mr. Windeler.

Electricity Supply in Great Britain.

THE latest return of engineering and financial statistics just issued by the Electricity Commissioners relates to authorised undertakers in Great Britain for the year ending March 31st, 1929, or May 15th, 1929, for public authority undertakers, and December 31st, 1928, for company undertakings. Like the Commissioners' previous returns, the publication is composed largely of tables, but there is a review of the whole situation. The return deals in all with 658 separate authorised undertakers, inclusive of the Central Electricity Board. The net addition to the plant capacity during the year amounted to 543,513 kilowatts, which was accounted for in part by the coming into operation of certain new generating stations, including the Longford station of the Coventry Corporation, the Maentwrog hydro-electric station of the North Wales Power Company, Ltd., and the new Brimsdown station operated by the North Metropolitan Electric Supply Company. In all there were 485 generating stations belonging to authorised undertakers in Great Britain, public authorities owning 262 and companies 223 stations. The total capacity of the plant installed in the stations at the end of 1928–29 was 5,801,770 kilowatts.

The vast difference in the outputs of these stations is shown by the fact that the capacities ranged from 18 kilowatts to 157,500 kilowatts in the case of the Barking station of the County of London Electric Supply Company, Ltd. The seventy-six largest stations, or 15·7 per cent. of the total, each having an installed capacity of 25,000 kilowatts or over, contained 4,015,177 kilowatts of generating plant or 69·2 per cent. of the total plant installed, whilst of the remaining 409 stations 200 had an installed capacity of less than 1000 kilowatts each. Needless to say, by far the largest proportion of the plant was of the steam turbine type, which accounted for 5,531,952 kilowatts. There were 138,806 kilowatts of steam reciprocating plant, 71,331 kilowatts of oil engine plant, 17,473 kilowatts of gas engine plant, and 42,208 kilowatts of water power plant. As compared with the position at the end of 1927–28, there was an increase of 540,042 kilowatts in the amount of steam turbine plant, a decrease of 22,157 kilowatts in the amount of reciprocating steam plant, an increase of 18,308 kilowatts in the amount of water power plant, and an increase of 8907 kilowatts in the amount of oil engine plant. Only 285,784 kilowatts, or 4·93 per cent. of the total amount of plant in operation, was of the direct-current type, and during the period covered by the return there was a decrease of 21,566 kilowatts of this plant.

As much as 5,426,412 kilowatts or 93·5 per cent. of all the generating plant, installed by authorised undertakers in Great Britain, consisted of steam turbo-alternators. The total plant capacity was made up of 2177 units—1123 alternating-current units and 1054 direct-current units, the latter comprising sets ranging from 1 to 6000 kilowatts, whilst the alternating-current units ranged from 10 to 40,000 kilowatts. One hundred and eighty-six alternating units of 10,000 kilowatts capacity or over were installed in the generating stations of authorised undertakers, and the aggregate capacity of these units amounted to 2,843,275 kilowatts, and representing about 49 per cent. of the total capacity of plant installed by all authorised undertakers. One hundred and sixty-nine stations generated alternating-current solely, 102 both alternating and direct current, and 214 stations direct current only.

Of the stations at which alternating current was generated, in 179 cases a generation voltage of 6600 volts or upwards was adopted, either wholly or in part, a large majority of these cases representing three-phase, 50-cycle generation at 6600 volts. At 30 stations generation was carried out either wholly or in part at alternating-current voltages of 10,000 volts or over, and in nineteen stations at voltages below 650, and in 64 other stations at voltages ranging between 1000 and 3000. The voltages in the majority of the direct-current stations ranged from 400 to 500, but at 76 stations the generating pressure did not exceed 250 volts. At two company stations direct-current generation was carried out at 1000 volts. During the period covered by the return, current was generated at twelve different frequencies, but the standard frequency of 50 cycles per second predominated, and was in use in 247 generating stations. The other principal frequencies were 25 and 40 cycles, the former being in vogue in 19 stations and the latter in 10 stations. As compared with the position at

the end of 1927–28, there was an increase of 542,919 kilowatts in the amount of 50-cycle plant and a net increase of 22,160 kilowatts in the amount of non-standard plant. The aggregate capacity of the 50-cycle plant installed at the end of 1928–29 was 4,379,877 kilowatts as compared with a total of 1,136,109 kilowatts for all other frequencies, representing respectively 79·4 per cent. and 20·6 per cent. of all alternating-current plant installed. The predominating non-standard frequencies of 25 and 40 cycles, together, accounted for 1,063,495 kilowatts, or nearly 94 per cent. of the non-standard plant. Over 74 per cent. of all the alternating-current plant installed was three-phase, 50-cycle plant.

The total rated evaporative capacity from and at 212 deg. Fah. of the boiler plant installed in all the generating stations dealt with in the return was 68,959,352 lb. per hour, the figure for public authority stations being 47,198,984 lb. per hour, and that for company stations 21,760,404 lb. per hour. The boiler plant was made up of 2487 units having 166 different rated evaporative capacities ranging from 1000 lb. to 180,000 lb. per hour, and 42 different working pressures ranging from 100 lb. to 475 lb. per square inch. Sixty-nine per cent. of the aggregate capacity in 1928–29 was accounted for by boilers having an hourly evaporative capacity of 30,000 lb. and upwards, as compared with 64 per cent. in the previous year and less than 30 per cent. in 1920–21.

Excluding the undertaking of Bournemouth, where supplies were given for public purposes only, the distribution systems of the other 642 undertakings were: Alternating current only in 219 cases, alternating and direct current in 264 cases, and direct current only in 159 cases. In the case of 19 undertakings—13 local authority and 6 company undertakings—where supplies to ordinary consumers were given on the direct-current system only, generation was carried out wholly or in part on the alternating-current system, or an alternating-current bulk supply was taken and converted to direct current for distribution. While alternating-current generation was carried out by authorised undertakers at 12 different frequencies, supplies at 15 different frequencies were distributed. In one of the additional cases, a bulk supply at 30 cycles was obtained from a non-statutory source, and in the two remaining cases where the supply was in process of being changed to 50 cycles, alternating current supplies at the former non-standard frequencies were being given through frequency changers. At the end of 1928–29 supplies at two or more different frequencies were being given at 22 undertakings, but in a number of these cases steps were being taken by the undertakers to eliminate the non-standard frequencies.

The predominating alternating-current low and medium voltages were 400, 230, 240 and 200 volts, and in the case of direct-current supplies 230, 460, 220, 240 and 480 volts. The diverse character of the declared voltages in vogue at the end of the period covered by the return is indicated by the fact that low and medium pressure supplies at pressures ranging from 100 to 480 volts were being given at 38 different voltages in the case of alternating-current supplies, and 26 different voltages in the case of direct-current supplies, the total number of declared voltages within the range in question for both classes of supply taken collectively being 44. These figures include associated pairs of voltages. There were 9 declared voltages exceeding 100, but less than 200 volts, and 17 declared voltages exceeding 200 volts, but less than 400 volts. Two hundred and forty-two undertakings—161 local authority and 81 company undertakings—were operating with three or more declared voltages within the range in question, 130 of the undertakings having four or more declared voltages and 37 five or more declared voltages.

During 1928–29 public authorities generated 5863·1 million units and companies 3460·6 million units, the corresponding figures for 1927–28 being 5309·9 and 3141·5 millions respectively. The number of units generated in 1928–29 showed an increase of over 872 million, or upwards of 10 per cent. on the figures for 1927–28. During 1928–29, the units sold by public authorities to consumers, inclusive of the retail distribution of bulk supplies, were 4964·6 millions and by companies 2835·5 millions, the corresponding figures for 1927–28 being 4477·2 and 2526·2 millions respectively. The sales to consumers in 1928–29 showed an increase of over 796 million units, or upwards of 11 per cent. on the figures for 1927–28. During the seven years which have elapsed since the period of severest industrial depression in 1921-22, the sales of electricity to consumers have increased from 3121 million to 7800 million, *i.e.*, by about 150 per cent., representing an average increase of nearly 670 million units per annum in that period.

For Great Britain as a whole, on the basis of the estimated population of 44·4 millions in 1928, the sales of electricity by all authorised undertakers in 1928–29 represented an average consumption of approximately 176 units per head of population, but it is to be understood that this figure only relates to the public supply of electricity and does not constitute a measure of the total consumption of electricity in Great Britain owing to the existence of numerous stations that do not belong to authorised undertakers and at which large supplies are generated for traction, colliery and other industrial purposes. The number of consumers connected at the end of 1928–29 showed an increase of upwards of 394,000, or about 15 per cent., on the figures for the previous year. Nearly 82 per cent. of the gross supply during 1928–29 was ultimately sold to consumers, the remaining 18 per cent. being accounted for by works requirements, transmission and distribution losses, &c. With regard to the different classes of supply, power supplies accounted for about 63 per cent., lighting and domestic supplies for 26 per cent., and traction supplies for about 9 per cent. of the total units sold to consumers. The sales of electrical energy for lighting and domestic purposes increased by 328 million units, while the sales for power purposes increased by 389 million units. During the year there was an increase of upwards of 394,000, or about 15 per cent., in the number of consumers of electricity. The combined maximum load on the public supply undertakings in 1928–29 based on units generated and/or purchased was in the neighbourhood of 4,077,000 kW and that on the generating stations of authorised undertakers in the neighbourhood of 3,369,000 kW. The capacity of the generating plant installed was about 72 per cent. in excess of the combined maximum demand upon it. The load factor of the generating stations of public authorities and companies was in the neighbourhood of 30 per cent. and 34 per cent. respectively, the combined figure being 31·6 per cent. The requirements of the electrical supply industry in 1928–29 involved the consumption of over 8,200,000 tons of coal and coke besides comparatively minor quantities of other fuel.

The progressive improvements in steam power station equipment and practice since 1920–21 have resulted in a reduction of the average fuel consumption per unit generated from 3·42 lb. in that year to 2·04 lb. in 1928–29. Technical developments have resulted in an all-round increase of 67 per cent. in the amount of electricity now obtainable per ton of fuel consumed at the generating stations of authorised undertakers as a whole, as compared with the position in 1920–21. There were 68 undertakings, 53 local authority and 15 company, at which 1000 units or over were generated per ton of fuel consumed at steam power stations during 1928–29, as compared with 67 in 1927–28 and 33 in 1926–27. The average fuel consumption in the cases in question ranged from 2·24 lb. to a minimum of 1·56 lb. per unit generated.

The total expenditure charged to capital account by authorised undertakings amounted at the end of 1928–29 to about £297,677,000, of which 41 per cent. was in respect of generation and 59 per cent. in respect of transmission, distribution, &c. The average expenditure for all purposes per kilowatt of generating plant installed was £51. The capital expenditure during the year 1928–29 amounted to upwards of £28,670,000, an increase of over 10 per cent. on the expenditure at the end of 1927–28. The total revenue in 1928–29 from the working of all authorised undertakings was £55,454,000, as compared with £53,330,000 in the previous year. The total revenue represented an average of 1·37d. per unit sold, the corresponding figure for the previous year being 1·49d. The average revenue per £100 of capital expenditure amounted to £18·6, this figure being reduced to £16·9 if revenue from the intersale of energy in bulk between authorised undertakers is excluded. The total working expenses, including the cost of all energy purchased in bulk by authorised undertakers, but excluding capital charges, were over £31,260,000 in 1928–29, as compared with about £30,040,000 in 1927–28. The working expenses absorbed 56 per cent. of the corresponding revenue from working in the previous year. The outstanding working expense was the cost of generation, which accounted for 35 per cent. of the total. Of the other principal items, distribution, management and rents, rates and taxes respectively, accounted for substantially equal percentages of the working expenses, local rates alone accounting for 9 per cent.

The average working expense per £100 of capital expenditure amounted to £10·5. The excess of revenue from working over working expenses amounted in 1928–29 to £24,188,000, and represented 8·1 per cent. on the capital expenditure at the end of that year. Allowing for revenue from other sources, amounting to £1,667,000, the gross surplus in 1928–29 was £25,855,000, representing 8·7 per cent. on the total capital expenditure at the end of the year. In the case of public authorities the gross surplus was appropriated to the extent of 35·1 per cent. for interest charges on loans and deposits, 48·4 per cent. for repayment of loans and transfers to sinking funds and to reserve and renewal funds, 10 per cent. for capital expenditure and 2·7 per cent. in relief of local rates, the latter item representing a net contribution of £414,509. The remaining 3·8 per cent., amounting to about £598,000, represented the increase in the balances on net account.

In the case of company undertakers the gross surplus was appropriated to the extent of 60 per cent. for interest charges and dividends, and to the extent of 33·4 per cent. for transfers to depreciation and reserve funds. About 3·4 per cent. of the gross surplus amounting to £350,535 represented the increase in the balances on net revenue account. The average rates of the preference and ordinary dividends calculated on the corresponding capital raised at the end of 1928 were 5·41 per cent. and 7·36 per cent. respectively. The position at the end of 1928–29 was that the capital or loan accounts of authorised undertakers were overdrawn to the extent of over £13,000,000; the balances in depreciation, reserve and renewal funds, including sinking funds in the case of public authorities, amounted to upwards of £29,000,000, and the balance on revenue account amounted to upwards of £4,500,000. In 1928–29 the electricity supply industry gave employment to over 56,700 people, including staff and workmen on generation, distribution and administration, the salaries and wages charged to revenue account amounting to £9,386,000.

Literature.

SHORT NOTICES.

Principles of Electrical Engineering. By William H. Timbie and Vannevar Bush. London: Chapman, Hall, Ltd. Price 22s. 6d.—Over six hundred electrical problems are contained in the second edition of this book, which aims at presenting to students the basic principles on which modern electrical engineering rests. Since the first edition was published seven years ago electrical engineering has made rapid progress, and the authors have endeavoured to make the volume meet present-day requirements. Special attention has been paid to the magnetic circuit, which the authors consider to be a stumbling-block to many students. Other branches of the subject covered are electrical units and electrical circuits, electric power and energy, the computation of resistance, electrolytic conduction, the magnetic field, the magnetic properties of iron and steel, induced electromotive forces, generated electromotive forces, the force on a conductor and thermionic conduction and conduction through gases. Although, for the most part, the book is elementary and is intended strictly as a first course on principles, the calculus is occasionally introduced. On the whole, however, elementary students should not find the volume difficult to understand. The main fault we notice is that, although the reader is given many problems to solve, the answers to these problems are not included.

Blacksmith's Manual Illustrated. By J. W. Lillico. London: Crosby Lockwood and Son. Price 9s. net.—The author of this book describes himself as a practical blacksmith, and in compiling this manual has given to the reader, in a very concise form, the benefit of many years of experience. The first section of the book includes illustrations of a complete range of the types of forges, tools and apparatus used by the smith, together with brief descriptions of their use and handling. The next chapter is devoted to some serviceable information in connection with the estimating of lengths and weights of materials. Forged work is then dealt with and many of the jobs a blacksmith has to do are described and the method of procedure is clearly shown. The finished job is first illustrated, and is followed by a series of sketches showing the operations which can be used to complete the work in the most expeditious manner. The book concludes with a section on the hardening and tempering of springs, dies and tool steels. The illustrations are exceptionally clear and the book is one which can be recommended to apprentices and all interested in smithy work.

BOOKS RECEIVED.

Machine Drawing and Design. By W. Abbott. London: Blackie and Son, Ltd., 50, Old Bailey, E.C. 4. Price 7s. 6d. net.

Praktischer Stahlschiffbau. By Dr.-Ing. E. Foerster. Berlin: Julius Springer, Linkstrasse 23, W. 9. Price 124 marks net.

The Petrol Engine. Third edition. London: The Temple Press, Ltd., 5–15, Rosebery-avenue, E.C. 1. Price 3s. 6d. net.

Modern Gas Fitting in Theory and Practice. Volume I. By S. T. Phillips and G. T. Tutt. London: Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 15s. net.

Standards Year Book, 1930. Compiled by the National Bureau of Standards. Washington: The Superintendent of Documents, D.C., U.S.A. Price 75 cents net.

Everyday Uses of Portland Cement. Fifth edition. London: Cement Marketing Company, Ltd., Portland House, Tothill-street, S.W. 1. Price 10s. 6d. net.

Einundzwanzigste Berichtfolge des Kohlenstaubausschusses des Reichskohlenrates. Berlin: V.D.I. Verlag G.m.b.H., Dorotheenstrasse 40, N.W. 7. Price 2·50 marks.

Mining Methods and Practice in the Michigan Copper Mines. By W. R. Crane. Washington: The Superintendent of Documents, D.C., U.S.A. Price 60 cents net.

Indice Bibliographico. Nos. 1 and 2, March and April, 1930. List of Technical and other Articles Published in Italian and Foreign Journals. Consiglio Provinciale Dell'economia di Milano, Biblioteca.

Cottage Hospitals. By Major F. M. Du-Plat Taylor, M. Inst. C.E., J. Coleridge, F.R.I.B.A., and Dr. J. J. Abraham, C.B.E., D.S.O., &c. London: Ernest Benn, Ltd., 154, Fleet-street, E.C. 4. Price 12s. 6d. net.

The Law Relating to the Compulsory Taking of Land by Public Companies and Local Authorities. Third edition. By T. Waghorn, revised by R. Borregaard. London: Effingham Wilson, 16, Copthall-avenue, E.C. 2. Price 5s. net.

Electrical Heating and Ventilation of Bourne and Hollingsworth's Premises, Oxford-street. By A. H. Barker, B.S.E., B.A., &c. Edited by H. H. Jeffcott, Sc.D., &c. London: The Institution of Civil Engineers, Great George-street, S.W. 1.

Annali dei Lavori Pubblici (già Giornale del Genio Civile), Ministero dei Lavori Pubblici, Consiglio Superiore. Anno LXVIII., Fasc. No. 3, Marzo, and Fasc. No. 4, Aprile, 1930. Rome: Provveditorato Generale dello Stato, Libreria.

The Automatic Stabilisation of Ships.

No. XII.*

THE general arrangement of the Schneider-Fieux twin-wheel gyroscopic stabiliser is shown in Fig. 40. This system follows the principles explained in the previous article in that the two wheels are mounted to precess about vertical axes. The wheels spin on their axles in opposite directions and are coupled together by toothed sectors fixed to their casings concentrically with the precession axes. As will be gathered from Figs. 41 and 42, the framework of the equipment consists of a base portion supporting a lyre frame, from the top of which horizontal arms project in the fore and aft direction. The wheels rotate inside open casings provided with upper and lower precession journals which work respectively in bearings in the horizontal arms and the base casting. In section the wheels are of the form shown in Fig. 43, this form having been selected in order "to free the boss from the centrifugal action of the peripheral mass"; that is to say, presumably, in order that any lack of complete concentricity of the wheel with the shaft may be self-adjusting. The

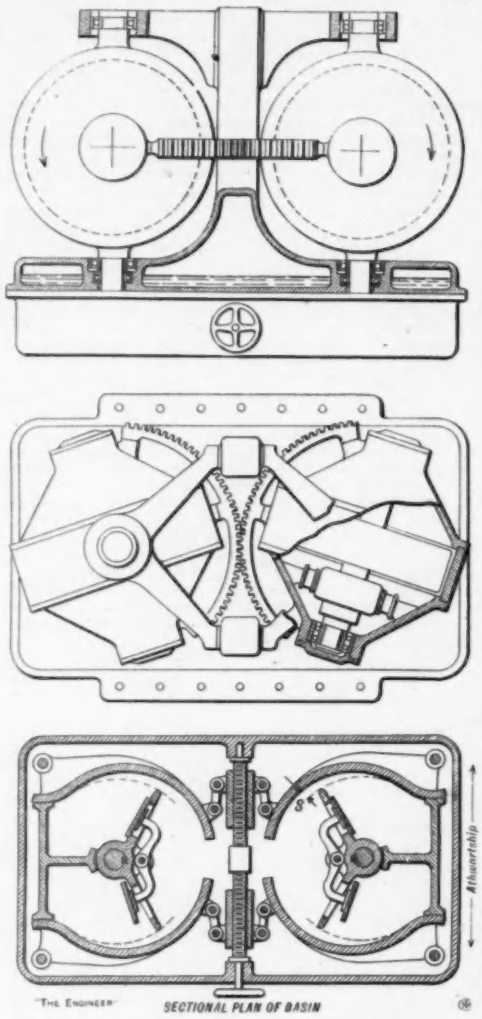


FIG. 40—FIEUX TWIN-WHEEL STABILISER

armature of the driving motor is keyed to the wheel shaft. The bearings for the shaft are carried on rollers and are cooled by air drawn through them by impellers on the shaft inside the casing. The hot air drawn off the bearings together with the lubricating oil is thrown through ducts into an oil-collecting chamber. Power for driving the motor of each wheel is led in through contacts at the upper precessional journal. A lock is provided which can be lowered to engage with the toothed sectors, thereby preventing the precession of the wheels and, consequently, suppressing the stabilising action of the equipment.

The novelty of the system, as we have already remarked, lies in the method employed for generating and applying the precessional moment. This method makes use of a remarkable form of hydraulic brake which lends itself to application about a vertical axis. It was, no doubt, the ease with which the brake system could be applied about a vertical axis that led Monsieur Fieux to arrange his gyroscope with a vertical precession axis and hence to employ twin-wheels coupled together.

Beneath the base casting carrying the lyre frame is a basin containing a liquid consisting of a neutral mixture of water and soluble oil. The lower precessional journal of each wheel casing is extended through into the basin and is there coupled to the boss of a two-armed lever. This lever, as shown in the plan view in Fig. 40, contains a clack valve in each of its arms. These valves are coupled together in such a way that when one is against its seat the other is full open. From an athwartship wall within the basin a short longitudinal wall extends up to the boss of the double-armed lever. At each end of the athwartship wall there is a curved leaf which is so pivoted that it may be moved inwards or outwards without losing contact with the end of the athwartship wall. The lever, the leaves and the walls extend from the foot to the top of the basin. As the leaves are adjusted in and out the area of the gap S between them and the ends of the lever arms is varied. The adjustment of all four leaves is achieved simultaneously by means of a right and left-handed screw operated from a hand wheel external to the basin. The setting of the leaves is varied manually to meet changes in the violence of the waves. It appears, however, that any one setting is capable of covering a considerable range of wave conditions and that the leaves have in general to be adjusted only at fairly long intervals. The curvature of the leaves is such that at any setting of the hand wheel the area S between the lever arms and the leaves decreases for one arm and increases for the other as the lever turns away from its mean position towards either side. It will be observed, too, that the pressure of the fluid closes the clack valve of that arm of which the area S is diminishing and opens the clack valve of the other arm, the corresponding area S of which is increasing. It follows, therefore, that when the lever turns the liquid trapped between one of the arms, one of the leaves and the fixed walls has to escape through an area S which diminishes in section as the rotation proceeds. On the other hand, the inflow of liquid into the corresponding space on the opposite side of the centre line is practically unrestricted, for not only is it given an increasing area S through which to pass, but it is afforded a passage by way of the open clack valve. The action taking place in one-half of the basin is independent of that occurring in the other. There is no actual division wall between the forward and the after ends of the basin, but if there were the action would be the same.

As a hydraulic brake the system has the merit that it entirely dispenses with the necessity for stuffing-boxes and the uncertain and arbitrary amount of frictional resistance to which they give rise. With the Fieux brake the moment applied about the precessional axis is, with the exception of the friction resistance at the ball or roller bearings in which the precessional journals are supported, entirely provided by the resistance to the motion of the clack valve arms through the liquid. That resistance is definite and governable.

It is not easy to analyse even on an approximate basis the magnitude of the resisting moment applied by the brake about the precessional axis of the gyroscope. It is, however, not unreasonable to assume that the action of the brake is comparable with that of a dashpot, in which case the resistance applied by the brake will be proportional to the viscosity of the liquid and to the velocity or some power of the velocity of the liquid through the passage S. The viscosity of the liquid may be taken as constant. We are, therefore, left with the velocity of the liquid through the passage S as the variable determining the magnitude of the resistance generated at any instant by the brake and applied by it as a moment controlling the precession of the gyroscope.

This velocity is dependent upon two factors, namely, the magnitude of the area S and the speed with which the arm is moving through the liquid. The area S diminishes as the gyroscope precesses away from its mid position. This diminution considered alone would cause the velocity of the liquid through the area to increase. On the other hand, the resistance applied by the brake to the gyroscope causes the precessional velocity to fall off as the precession proceeds. This decrease considered alone would cause the velocity of the liquid through the area S to diminish. The net result, therefore, is that as the gyroscope precesses away from its mid position, the velocity of the liquid through the area S and, therefore, the resistance applied by the brake, increases from some value to a maximum and then falls to zero as the precessional velocity vanishes at the limit of the precessional movement.

Continuing the argument on these lines we can obtain some idea of the resistance applied by the brake to the gyroscope if it now moves back from the limit of its amplitude to the mid-position. The clack valve of the first arm, previously closed, opens when the return movement starts and the clack valve of the second arm, previously open, closes. At the start of the return motion the second arm is displaced from the mean position shown in the plan view of Fig. 40. Its end may, if the amplitude has been sufficiently great, be opposite the gap between the leaves, in

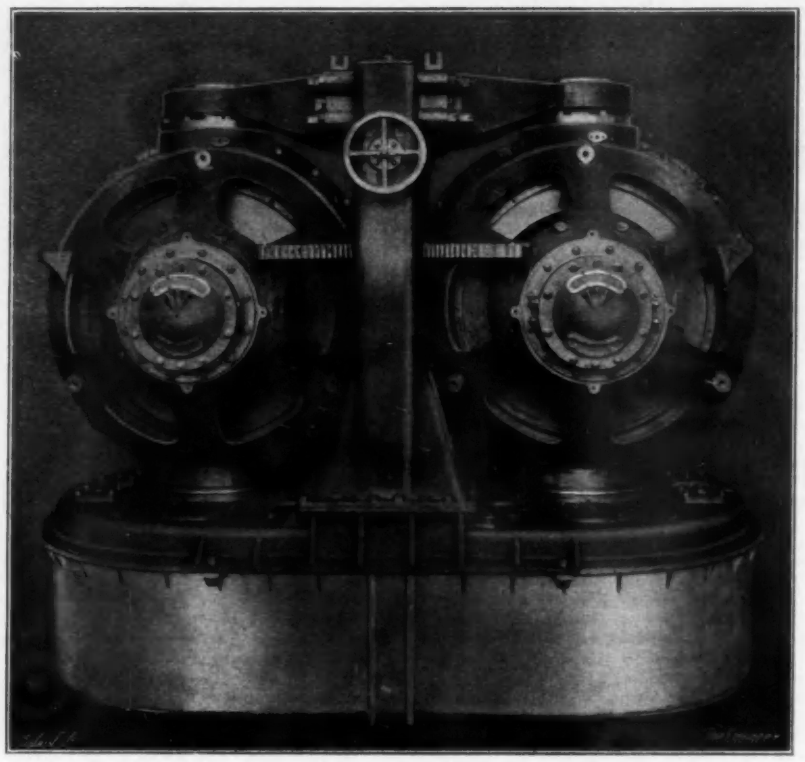


FIG. 41—FIEUX STABILISER FOR A FRENCH DESTROYER

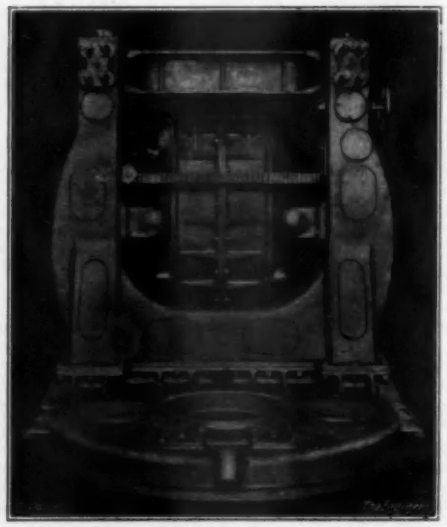


FIG. 42—LYRE FRAME AND BASE

* No. XI. appeared June 13th.

which case the area S may be considered to be infinitely great. In any event the area will be considerable. Moreover, the velocity with which the gyroscope begins its return to the mid-position is low. Hence at the start of the return movement the resistance applied by the brake may be considered to be substantially zero. As the return proceeds the area S diminishes. The resistance therefore increases until the gyroscope reaches the mid-position. If the gyroscope is oscillating uniformly about the precessional axis its precessional velocity will now be the same—but opposite in direction—as it was at the beginning of the first quarter portion of its swing. The area S will also be the same. Hence the resistance at the instant when the gyroscope returns to the mid-position will be the same in magnitude as it was at the start of the first quarter period, but opposite in direction.

During the third quarter period as the gyroscope is swinging away from the mid-position to the opposite

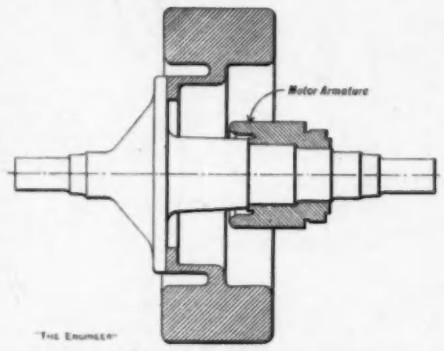


FIG. 43—SECTION OF FIEUX WHEEL

side the resistance will rise to a maximum value and then fall to zero at the limit of the amplitude just as it did during the first quarter period. For the fourth quarter period when the gyroscope is returning to the mid-position the resistance will rise from zero to the value associated with the mid-position conditions.

In general, then, we may say that if curve A in Fig. 44 represents the precessional angle or swing of the gyroscope the resistance applied by the brake against the precession will vary in some such manner as that represented by curve B. The curves are not drawn to any particular scale, for our verbal analysis does not provide a quantitative basis. Qualitatively, however, the argument is probably correct. It is certainly correct in one important respect. The moment applied by the brake about the precessional axis may fall to zero at certain times, but at all other instants it acts to *resist* the precession. At no time can it act to *assist* the precession. We have shown previously that the requirements for complete stabilisation are that the precessional moment should resist the precession during the first and third quarter periods of the

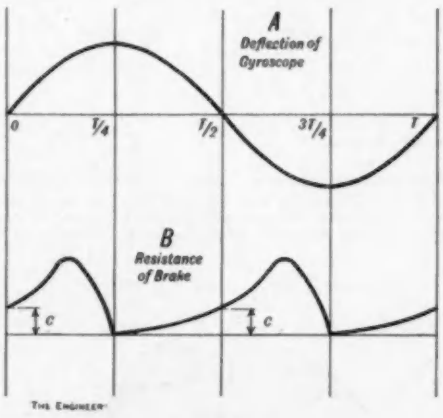


FIG. 44—CURVE OF BRAKE RESISTANCE

oscillation of the gyroscope and should assist the precession during the second and fourth quarter periods.

Without a knowledge of the precise magnitude of the resistance applied by the brake about the precessional axis it is impossible by analytical methods to determine how far the Fieux system is deficient in supplying the reaction required for the complete stabilisation of any vessel to which it may be fitted. The deficiency arises primarily during the second and fourth quarter periods when the gyroscope is returning to its normal position from the limits of its oscillation. During these two quarter periods the average resistance applied by the brakes may be low, but even if it were zero the system would still fail to provide the reaction required for complete stabilisation. The "natural" precessional velocity impressed by the heeling moment of the waves on the gyroscope during its return to the mid-position is, as was shown in article No. VII., insufficient to produce a reaction, the vertical component of which will just balance the heeling moment. To achieve the balance the precessional velocity has to be increased above the "natural" value by external assistance.

A secondary cause of deficiency resides in the fact that while the precession is retarded during the first and third quarter periods, the resistance does not, as it should do for complete stabilisation, rise from zero. At the beginning of these two quarter periods the resistance of the brakes is of some fair amount, as indicated by *c* in Fig. 44. When the gyroscope is moving through its mid-position the area S, Fig. 40, for the operative arm is already less than its maximum value. The initial resistance cannot therefore be zero.

The Fieux system, it will be seen, cannot fulfil the conditions for complete stabilisation. Like the Sperry system, which is similarly situated, it can, however, afford a degree of partial stabilisation. During the first and third quarter periods of the oscillation of the gyroscope the principle of its action is capable of providing a considerable percentage of the reaction required for complete stabilisation. During the second and fourth quarter periods it is capable of providing a considerable percentage of the reaction corresponding to the "natural" precession appropriate to the size and speed of the wheel and the magnitude of the waves.

The first, and so far as we know the only, vessel to be fitted with a Fieux stabiliser up to the present was a French torpedo-boat destroyer having a displacement of 880 tons and a metacentric height of 1·9ft. corresponding to a period of roll of 7 sec. The wheels supplied for this ship had each a diameter of 3ft. 11in. and ran at 2150 r.p.m. The complete equipment weighed 12·3 tons, to which has to be added 1·5 tons for the weight of the liquid in the brake system. The total weight of the apparatus was therefore equivalent to 1·57 per cent. of the vessel's displacement—a very low figure. The space occupied by the equipment measured 5ft. 7in. in width, 8ft. 6in. in height, and 9ft. 2in. in length. The power required to drive the two wheels was 24 kW.

The section of the wheels being as shown in Fig. 43, each would have a weight of 2 tons and a moment of inertia of 5·45 in tons and feet. The peripheral velocity would be 441ft. per second, corresponding to a centrifugal tension of 9·17 tons per square inch. The oscillations of the gyroscopes were limited by buffer stops to a maximum of 60 deg. on each side of the mid-position.

We may apply the approximate formula

$$\alpha = \tfrac{1}{8}\, C\, r\, g\, T/\dot{\phi}\, I$$

in order to determine how far the wheels provided approach the requirements for complete stabilisation apart from any question concerning the adequacy or otherwise of the precessional moment given by the brake system. On the "standard" wave—T=6·28 sec., $r=1/20$—and taking α at the maximum value of $\pi/3$, we get from this formula $\dot{\phi}\, I = 8407$ in terms of tons, feet and radians per second. For the wheels provided by Monsieur Fieux $\dot{\phi}$ has the value 225 radians per second and I is equal to 5·45. The combined "power" $\dot{\phi}\, I$ of the two gyroscopes fitted in the destroyer is therefore 2452, or only about 30 per cent. of the value required for complete stabilisation on the "standard" wave. In other words, the size and speed of the wheels provided, apart altogether from any question of the adequacy of the precessional moment system, were sufficient to stabilise the vessel completely on a wave having the period and length of the "standard" wave, but only 3ft. instead of 10ft. in height.

The destroyer was tried off Brest. It was found that the effectiveness of the equipment was very irregular, and that it was greater when the sea was choppy than when a long regular swell was encountered. When the wave conditions were such as to cause the vessel to roll through 40 deg. with the stabiliser out of action, the effectiveness of the equipment when it was brought into use was not more than 50 per cent. An exact definition of "effectiveness," as employed by Monsieur Fieux, is not available. We take it to mean the ratio of the amount by which the roll was reduced with the equipment in action to the roll recorded with it idle.

We have already noted the low ratio of the weight of the Fieux equipment to the displacement of the vessel on which it was fitted, and have used the approximate method of analysis developed in our preceding articles to estimate the extent to which the "power" provided was insufficient to meet the ideal requirements for complete stabilisation. It is therefore of interest to note that Monsieur Fieux, as a result of the trials, had to admit that his gear was too light. The weight was, as remarked above, 1·57 per cent. of the displacement. As a result of his experience with his first equipment, Monsieur Fieux came to the conclusion that for a cross-Channel steamer of about 2500 tons displacement the total weight of the equipment required to stabilise her on his system would have to be about 2½ per cent. of the displacement, or something over 60 tons. That figure was challenged at a meeting of the British Section of the Société des Ingénieurs Civils de France, held in London in November, 1928. It was suggested that for a vessel of the size and type specified, Monsieur Fieux would require an equipment having a total weight of 120 tons or so.

Let us endeavour to settle this point by an appeal to our approximate method of analysis.

A rational value for the metacentric height of a cross-Channel steamer is 18in. We will suppose that the equipment is to be designed to impart *complete* stability to the vessel when she encounters waves of any magnitude up to our "standard" train of period 6·28 sec. and height-to-length ratio of one-twentieth, and that on the standard train the oscillation of the twin gyroscopes is through a range of 60 deg. on each side of the mean position. The approximate formula, $\alpha = \tfrac{1}{8}\, C\, r\, g\, T/\dot{\phi}\, I$, using these data gives the "power," $\dot{\phi}\, I$, for a 2500-ton vessel, at 18,880 in terms of tons, feet and radians per second. Each of the two wheels has therefore to have a power of 9440. In order to keep the centrifugal tension in the wheels at the same value as that used in Monsieur Fieux's first equipment, we must make the peripheral velocity the same, namely, 441ft. per second. The angular velocity $\dot{\phi}$ will therefore be 441/R, where R is the radius of the wheel. We will take it that the wheel is to be of the same proportions as that shown in Fig. 43. On that assumption the moment of inertia of the wheel will be $422{\cdot}5\ R^5$, in terms of pounds and feet, and therefore the quantity $\dot{\phi}\, I$ will be $83\ R^4$ in terms of tons, feet and radians per second. Equating this expression to the value of the "power" required, namely, 9440, we get R=3·26ft. We therefore obtain the following particulars for the wheels to be provided :—

Stabiliser for a 2500-ton Cross-Channel Steamer. Twin Gyroscopes.

Diameter of wheel	6ft. 6½in.
Inside diameter of rim	4ft. 2½in.
Width of rim	2ft. 2in.
Speed of wheel	1288 r.p.m.
Centrifugal tension in rim	9·17 tons/sq. in.
Weight of wheel	9·37 tons

The two wheels together would therefore weigh 18·74 tons. In the installation fitted on the French torpedo boat, the wheels weighed 4 tons together, and the total equipment 13·8 tons. The wheels therefore accounted for 29 per cent. of the total weight. If we assume that a similar distribution of the weight is achieved in the case of the hypothetical cross-Channel vessel, the total weight of the equipment will be 64·6 tons or 2·58 per cent. of the displacement. Monsieur Fieux's estimate of the requirements was, as we have said, about 2·5 per cent. of the displacement.

It should be noted in considering this result that while the figures for the metacentric height, &c., were not selected with a view to bringing about a striking agreement with Monsieur Fieux's estimate, we premised that on our arbitrary standard wave the oscillation of the gyroscope was to reach 60 deg. on each side of the mean position. That degree of oscillation marks the limit set by Monsieur Fieux in his first equipment. In other words, on the standard wave our assumption means that the equipment would be working to the limit of its capacity in the case of the cross-Channel steamer. If it were deemed desirable to provide stabilising equipment to meet the conditions imposed by waves of greater magnitude than the standard, the wheels required would have to be of greater weight than we have assigned to them.

It should be understood that this examination of the problem has been made without reference to the manner in which the precessional moment is applied or its extent and mode of variation. It is not based on the assumption that the precessional moment system is that provided by Monsieur Fieux's hydraulic brakes. The Fieux equipment is deliberately designed to give partial and not complete stabilisation. Its brake system is not consistent with the requirements for complete stabilisation, whatever be the size of wheel employed.

(To be continued.)

The Millam Free Wheel and Sprag.

AN appliance known as the Millam Free Wheel and Sprag has recently been put on the market by Frictionless Mastagear, Ltd., of Saville Chambers, Saville-row, Newcastle-upon-Tyne. The apparatus, which is patented and the sole manufacturers of which are Sir W. G. Armstrong, Whitworth and Co., Scotswood Works, Newcastle-upon-Tyne, is a mechanism intended for insertion in the propeller shaft of motor vehicles, and its use is claimed to result in the following advantages :—

(*a*) *Free Wheeling.*—The moment the foot is taken off the accelerator the engine revolutions die away to just "ticking over," and the car "coasts" along. When the accelerator is again pressed down, the load is once more taken up.

(*b*) *Gear Changing.*—In changing gear it is not necessary to de-clutch, and any gear can be readily engaged, irrespective of the speed at which the car may be running.

(*c*) *Petrol Saving.*—The moment the foot is taken off the accelerator pedal, the engine automatically runs on the pilot jet, and no more petrol is used than when the car is stationary with the engine just turning round. In consequence, a saving of petrol, averaging about 25 per cent., is experienced. Without the free-wheel, as soon as the foot is taken off the accelerator pedal, the compression of the engine rapidly brings the car to a standstill.

Oil Saving.—Owing to the fact that the engine is never used as a brake, except when the direct drive is engaged, vacuum is not formed in the combustion chamber and oil is not sucked into the combustion chamber where it would be burnt and its lubricating properties weakened. Hence, there is a considerable saving in oil which is found in practice to amount to from 25 to 60 per cent. Furthermore, the interval of time at which de-carbonisation becomes necessary is extended to twice the normal.

Extra Factor of Safety.—The apparatus adds considerably to the factor of safety. In the event of a vehicle getting out of control when running downhill, it is possible to change into first, second or third gear at any speed, and then, when the free wheel is cut out by the movement of a small handle, the engine brake becomes available.

Clutch.—As the clutch is only used about one-tenth as much as it is in a car not fitted with the mechanism, the wear and tear of the former is reduced proportionally.

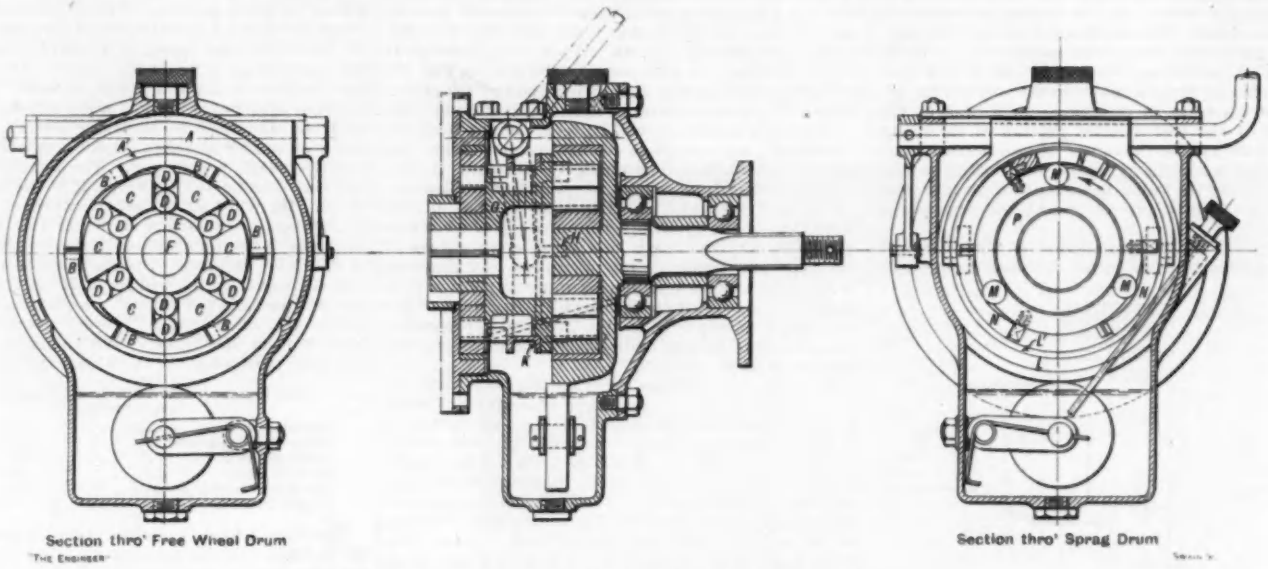


FIG. 1—SECTIONS OF THE MILLAM FREE-WHEEL AND SPRAG

Strain on the Engine, Transmission, and Driver.—It is estimated that 90 per cent. of the reversal stresses on the engine and transmission is removed while the engine is free wheeling. In actual practice, it is stated, it is found that on average main roads the distance covered when free-wheeling works out at from 35 to 45 per cent. of the total distance travelled. Moreover, a very large proportion of the strain of driving is taken from the driver. The fact that the clutch has not to be used when gear-changing, is a point to which attention is specially drawn, and it is asserted that the feeling of effortless and noiseless motion when free-wheeling has only got to be experienced in order to be appreciated.

Rear Tires.—As the rear tires are rolling and not being driven for from 35 to 45 per cent. of the distance travelled, they last much longer than do those on a car which is not fitted with the free wheel.

It must be admitted that the foregoing claims are of a most far-reaching character, and it certainly would seem that, if they can all be substantiated, free wheels are likely to be fitted to a large proportion of motor vehicles. In this connection the company refers to what it says is a popular idea, namely that the brakes are used very much more on a car fitted with a free wheel than they are on a vehicle not so equipped. That, it asserts, it has proved to be a fallacy; it is really just a case of anticipation and practice to obtain the best results.

The construction of the mechanism will be readily understood from the accompanying engravings. The gear is, virtually, an automatic metal-to-metal clutch, fitted with rollers, the drive in the apparatus, as applied to ordinary cars, being taken between the outside faces of six segments and the inside surface of a driven drum. The rollers themselves are not called upon to take the drive between the driving and driven members. That would give line contact only, and consequently a limited wearing life and subsequent slip.

The driving portion of the free wheel consists of a cage G—Fig. 1—for the rollers, which is provided with six jaws C, between each of which lies a pair of rollers D. On the outside of the rollers and immediately inside the drum and its liner—A, A^1 respectively—are six driving segments B, which are shaped on their inner faces to form double-acting wedges, their outer faces being ground to the same curvature as the inner surface of the drum liner, with which they engage when under load. On the inside of the rollers is a hardened steel roller path E, keyed to a box inside the driven drum.

"It is pointed out by the inventor that the fact that the roller path is an integral part of the driven drum is very important, as it means that the radial thrust on the segments and drum, so that no slip can take place no matter what torque is transmitted—provided, of course, that the angle of the wedge surfaces of the segments is less than the angle of friction between the segments and the drum. The best angle has, we are informed, been determined after a long period of tests with various materials for the drum liner A^1 and the segments B, and using various kinds of lubricating oil.

Another function of the roller path is to cause the rollers to rotate slightly by reason of the momentary and slight relative rotary movement of the roller cage and roller path, when the load is on the point of being taken up. This slight rotation of the rollers causes the outer rollers to roll positively along the wedge surfaces on the inner faces of the driving segments, and helps the action of the drum itself in dragging the segments over the rollers. This action, it is stated, gives a sure and instantaneous take-up of the load, and eliminates the possibility

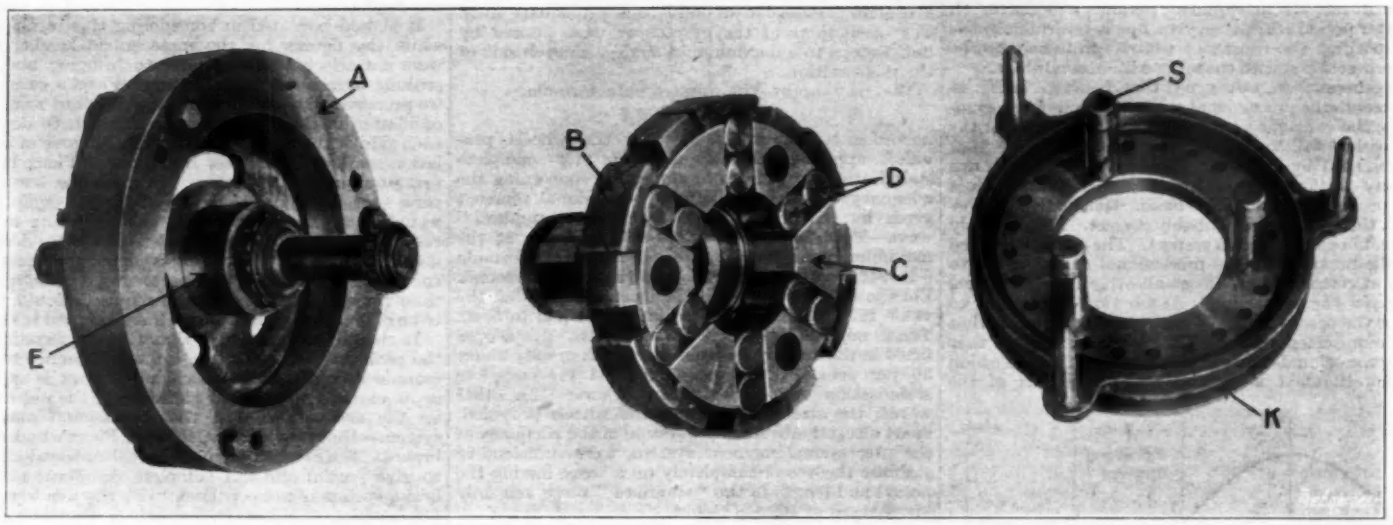


FIG. 2—COMPONENT PARTS OF THE MILLAM FREE-WHEEL GEAR FOR HEAVY VEHICLES

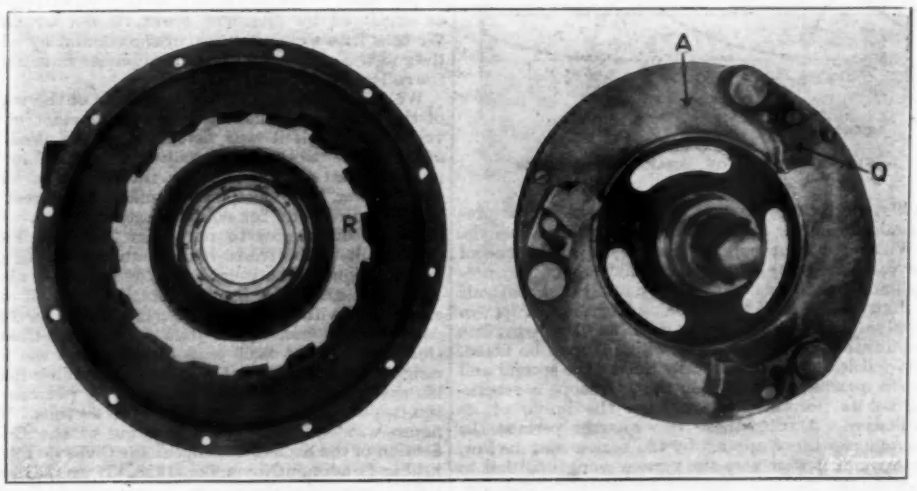


FIG. 3—SPRAG GEAR FOR HEAVY VEHICLES

is explained, becomes, in actuality, an ordinary dog clutch, the driving portion of which consists of the six jaws on the driving member and the driven portion the rigid structure formed by the roller path, the rollers,

of slip. As has already been mentioned, the roller path also takes the reaction of the outward radial thrust on the segments.

When the mechanism is used purely as an over-running device, the wedges are restrained from rotary movement in one direction, relatively to the cage, by means of axially sliding fingers H, so that no wedging action can take place when the car overruns the engine. When, however, it is desired to use the mechanism as a solid coupling, the restraining fingers are withdrawn, whereupon the wedging action can take place in both directions of rotation and the necessary automatic pressure is put upon the driving segments, whether the engine is driving the vehicle forward, is being used as a brake, or is driving the vehicle in reverse. The six axially sliding fingers are actually made in the form of prongs H on the side of the grooved controlling sleeve K, in which groove lies a shoe or cod-piece attached to an operating fork.

When the free wheel comes into action it does not do so with a hammer shock, as the double-wedged segments have first to squeeze out a film of oil before actual metal-to-metal contact takes place, and the squeezing out of the oil introduces a time factor which results in the gear coming into action without jar. The moment metal-to-metal contact takes place, there is no further slip or creep, the angles being such that the greater the torque, the greater the grip.

Embodied in the same casing as the free wheel mechanism, is an automatic sprag which prevents a vehicle, when stopped on a hill, from moving backwards, even though the brakes are off and the gears are in neutral. The moment the vehicle stops, the wheels are automatically locked. Starting from rest on an upward incline has up to now been a troublesome operation to perform, and, indeed, is a not infrequent cause of accident, owing to the difficulty of releasing the brakes, putting in the gear, accelerating the engine, and letting the clutch in all at once. It is claimed that with the Millam sprag, starting from rest on a hill is as simple as starting from the level. No vehicle fitted with it can run backwards, except when the gear lever is put into reverse, which operation automatically cuts out both the sprag and the free wheel.

The action of the spragging mechanism is similar to that of the free wheel. The equivalent of the driven portion —L, L^1 in the spragging mechanism—is, however, fixed non-rotationally to the chassis of the vehicle. In the case of the sprag, too, a somewhat different arrangement of rollers is used, as will be seen from the right-hand drawing in Fig. 1. A single roller M only is used in conjunction with each wedge segment N, of which only three are provided.

In order to allow of free roller action along the wedge surfaces, the single rollers bear on a floating central path P, and not on a fixed path as in the construction already described for the double-roller free wheel mechanism. Incidentally, we are informed that, in an alternative arrangement of the gear, which has given equal satisfaction on test to the twin-roller fixed-path system, both the free wheel and sprag mechanisms are arranged on a single-roller, floating-path system.

In the models now being fitted to ordinary vehicles, the sprag portions of the gear are, we understand, slightly modified from those shown in the illustrations; the principle is the same, but a bob weight is provided for each segment, and is so arranged and pivoted that, when the vehicle is in motion, centrifugal force acts on the bob weight, and causes a finger on the bob weight stamping, at the end remote from the pivot, to be depressed into a groove cut in the outer surface of the segment. That movement causes the withdrawal of the segment from contact with the stationary drum, while the vehicle is in motion, but the segment makes contact with the drum again immediately the vehicle comes to rest. There is thus no possibility of any friction being set up by the sprag when the vehicle is in motion.

The sprag gear for heavy vehicles differs considerably from that of the pleasure car, as it was thought advisable to have a definite ratchet sprag. Moreover, single-acting wedges are used in place of double-acting wedges. The solid drive is obtained by the use of dogs S—Fig. 2—between the driving and the driven portions. The spragging arrangement is also slightly different. It consists, in the heavy vehicle gear of pawls Q—Fig. 3—pivoted on the driven drum, which engage with a ratchet R fixed in the casing.

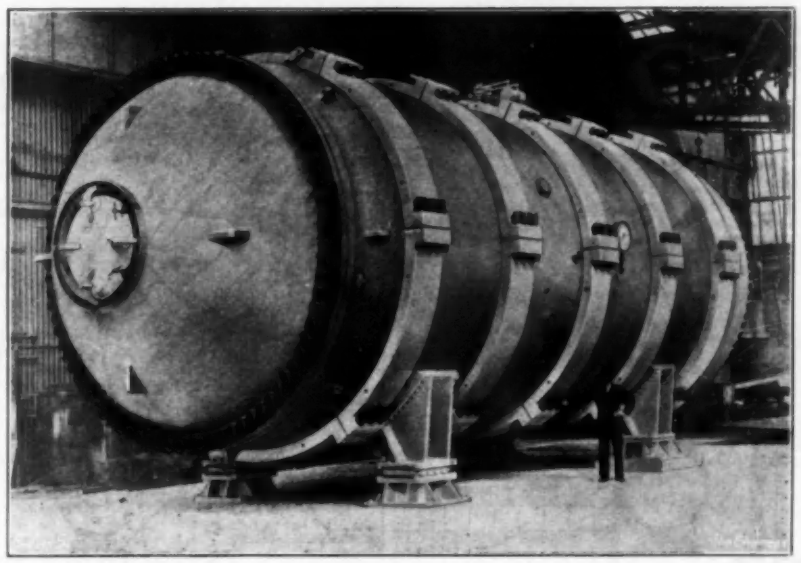
We are informed that before this gear was put on the market, it was submitted to severe and prolonged tests. During those tests it was run for many thousands of miles applied to a fully loaded vehicle with every conceivable condition of road and speed of vehicle. Many miles were run at dead low speed, and many at very high speed. Finally, a fully loaded omnibus was subjected to 5000 consecutive sprags in order to submit the rollers and wedges to severe crushing stresses. On opening up the gear at the end of this series of tests it was found to be intact and quite unmarked.

The company has prepared a list of the savings which, it maintains, would be achieved by using the Millam apparatus on any ordinary omnibus running from 900 to 1000 miles per week. In the first place, it is claimed that there would be a saving of 10 per cent. in petrol consumption, which, taking the 10 per cent. at 1½ gallon per day and petrol at 1s. per gallon, would amount to £27 per year. A 10 per cent. saving in lubricating oil would, with oil at 4s. a gallon, represent £2 10s. The saving in having to decarbonise only twice a year instead of six times is put at £7, the cost of each decarbonising being estimated at 35s. Then, a saving of £25 is claimed in the maintenance of engine lubrication, clutch, gears, transmission shafts, back axles and back tires. Finally, it is stated that the vehicle will last 25 per cent. longer than a vehicle not fitted with the gear. Assuming that the omnibus originally cost £1200, and that it would ordinarily go out of service in four years, the depreciation would amount to £300. Hence, as the life of the vehicle would be five years instead of four, the saving per annuam with a fitted vehicle would amount to £60. The total annual saving for a fitted vehicle is therefore claimed to be £121 10s.

A HYDRAULIC movable coal hoist is to be installed at the North Dock, Newport, of the Great Western Railway. It is to be supplied by Vickers-Armstrongs Ltd.

HIGH-PRESSURE AERONAUTICAL RESEARCH TUNNEL

JOHN BROWN AND CO., LTD., SHEFFIELD, ENGINEERS



Variable Density Tunnel.

THE above engraving shows a variable density tunnel, which has been manufactured by John Brown and Co., Ltd., Sheffield, the principal dimensions of which are: length 50ft. and internal diameter 17ft. It is the largest structure of its kind that has ever been produced, and is built up of four seamless hollow rolled steel rings, each of which in the rolled state weighed 50 tons, and which are the largest seamless rolled steel rings which have ever been produced in the world. No other firm, apart from John Brown and Co., would, we understand, be able to undertake their construction.

The hemispherical ends are each made of two steel castings joined together by a flanged and studded joint. The castings weighed 26 tons each and were made by Thomas Firth and Sons, Ltd., who are, of course, closely associated with John Brown and Co., Ltd. A very difficult feature in connection with the structure was the joining of the separate sections of the vessel, which has been effected by a special form of butt strap clearly seen in the illustration.

This tunnel will be erected at the National Physical Laboratory at Teddington and is to be used for special experiments in connection with aircraft. The total weight of the structure as illustrated is approximately 250 tons. The tunnel was subjected to and successfully passed an hydraulic test pressure of 550 lb. per square inch.

INSTITUTION OF ELECTRICAL ENGINEERS' CONVERSAZIONE.

THE annual Conversazione of the Institution of Electrical Engineers was held at the Natural History Museum on Thursday, June 12th, when over 1600 guests were received by the President, Colonel Sir Thomas F. Purves and Lady Purves. The string band of the Royal Engineers played in the Grand Central Hall from 8.30 to 11 p.m., and there was also a concert from 9.30 to 10.30 p.m. During the evening the President presented a congratulatory address to Colonel R. E. Crompton, on his attaining the age of eighty-five. The text of the address was: "The President and Council of the Institution of Electrical Engineers desire to convey their heartiest congratulations to its estimable past-President, Colonel Rookes Evelyn Crompton, on the occasion of his eighty-fifth birthday on 31st May, 1930, and cordially wish him *ad multos annos*. His pioneer work in the advancement of electrical science and engineering and their applications, which is universally recognised, entitles him in the fullest degree to the respect and admiration of electrical engineers. As a mark of appreciation of the great services rendered by Colonel Crompton to the electrical engineering profession during his fifty years' membership of the Institution, he was elected one of its honorary members in 1923, and was awarded its Faraday Medal in 1926." The address is signed by the President, Colonel Sir Thomas F. Purves, Mr. W. M. Mordey, and the secretary, Mr. P. F. Rowell.

BRITISH EMPIRE TRADE EXHIBITION, BUENOS AIRES, 1931.

As previously announced, a British Empire Trade Exhibition is to be held at Buenos Aires from March 14th to April 27th, 1931. It is being held as the result of the initiative of the British Chamber of Commerce in that city. This Exhibition—the first of its kind to be held in South America, or indeed in any foreign country—is being officially supported by his Majesty's Government, and the Department of Overseas Trade is organising an exhibit in a building which has been provided by the Exhibition management. Other steps will be taken, in addition, to bring the prestige of this country prominently to the notice of the Argentine people. The British banks, railways, shipping and cable companies, and other British commercial undertakings in the Argentine are giving the scheme their warm approval and financial support, and the Argentine Rural Society has placed its grounds adjoining Palermo Park, in the centre of the city, and the buildings which they contain, at the disposal of the organisers. In addition, temporary buildings are being erected as the needs of the enterprise dictate. The Canadian Government is also organising a series of exhibits.

The Exhibition will be split up into a series of industrial sections, which will include textiles, wearing apparel, footwear; applied science, chemicals, foodstuffs, beverages, toilet requisites; applied art, furniture and sport; building and decoration, household machinery, &c. The machinery group will consist of sections representing electrical equipment, hardware, small tools, light machinery, &c., heavy machinery of all descriptions, agricultural machinery and implements, factory equipment, heavy chemicals and oils, locomotives, railway and tramway equipment, road-making machinery, motor cars, cycles, and commercial vehicles, aviation and motor boats.

Full particulars regarding the undertaking can be obtained on application to the general manager, British Empire Trade Exhibition, Buenos Aires, 1931, 5, Parliament Mansions, Orchard-street, Victoria-street, London, S.W. 1. Telephone Victoria 0877.

INSTITUTIONS OF ENGINEERS AND SHIPBUILDERS.

JOINT SUMMER MEETING IN HOLLAND.

THE North-East Coast Institution of Engineers and Shipbuilders and the Institution of Engineers and Shipbuilders in Scotland are to hold a joint Summer Meeting in Holland from to-morrow, the 21st inst., till the following Saturday.

The party will leave Harwich at 11.45 to-morrow morning, arriving at Flushing in the evening, where the night will be spent. The following day will be devoted to a round trip through Walcheren at the invitation of the Schelde Yard, which will be followed in the evening by an informal dinner at the Hotel Britannia, Flushing, at the invitation of the Reception Committee.

On the Monday the Schelde Yard will be inspected and on the Tuesday there is to be an all-day visit to the Zuiderzee Works, the party proceeding in the evening to Scheveningen.

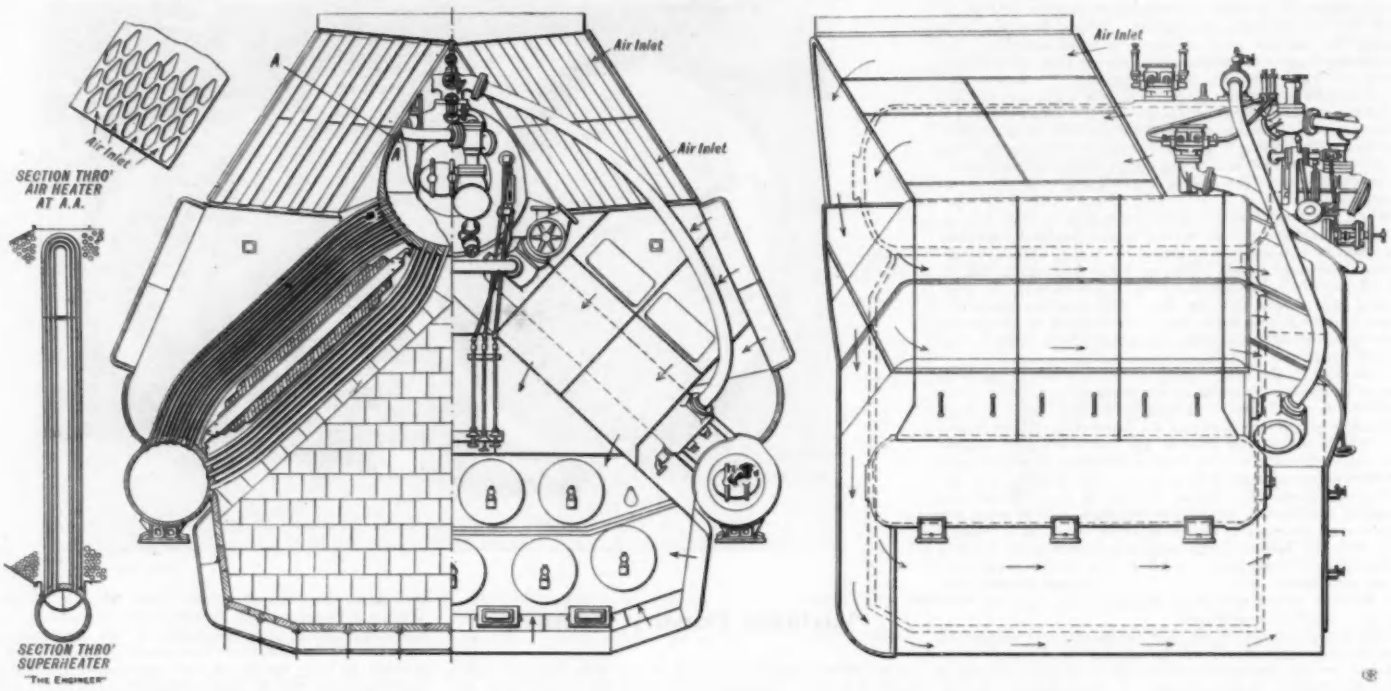
On Wednesday, the 25th inst., at 10 a.m., a meeting will be held at the Kurhaus, Scheveningen, for the reading and discussion of the following papers:—"The Interior Architecture of Ships," by Professor Percy A. Hillhouse and Mr. A. McInnes Gardner; and "Notes on the Progress in Transportation of Oil by Sea and Possible Future Developments," by Mr. John McGovern, President-elect, N.E.C. Inst. In the afternoon there will be an excursion to Old Wassenaar Castle, and in the evening there is to be a Reception at the Hotel de Twee, Steeden, The Hague, at the invitation of the Burgomaster and the City Council of The Hague.

On the Thursday and Friday there will be various visits to Amsterdam and Rotterdam, and to works and places of interest in the neighbouring districts, and on the Friday evening a dinner will be given at the Palace Hotel, Scheveningen, by the two Institutions in honour of their hosts.

WINDOWLESS factories lighted by artificial means were urged by Dr. E. E. Free, consulting engineer and scientist, at the second annual illuminating conference in the Westinghouse Lighting Institute, New York. It was asserted that the omission of windows would save about 5 per cent. in building costs and 40 per cent. in maintenance expenses, would facilitate control of heat and circulation of air and increase the efficiency of workers. Dr. Free added:—"The lighting in a factory illuminated by daylight is changing constantly, so that only for short periods every day will each machine, desk or work bench receive that kind and amount of light best suited to the eye. Artificial lighting, however, does not mean present average daylight illumination, but from five to ten times that amount."

MARINE WATER-TUBE BOILER

JOHN I. THORNYCROFT AND CO., LTD., SOUTHAMPTON, ENGINEERS



Marine Steam Boiler.

AN interesting boiler embodying the latest developments in high-pressure boilers for service afloat is shown above. This is one of a batch nearing completion by John I. Thornycroft and Co., Ltd., Southampton.

Each boiler has a total surface of 8880 square feet designed for 500 lb. working pressure and a superheat of about 280 deg. Fah., the air being preheated before reaching the burner openings.

These boilers were designed by John I. Thornycroft and Co., in collaboration with the Admiralty, and several novel features have been embodied in the design.

The barrels, which were made by John Brown and Co., Sheffield, are of forged steel with ends closed in, and machined all over internally and externally. The top barrels are 2⅜in. thick in way of the tube plates, and the lower barrels 1 ⅝in., and the shell is made flange thickness in way of mountings to enable pads to be dispensed with. The generating tubes are of seamless solid drawn steel, the two fire rows being 1¾in., the next four before superheaters 1¼in., and the remainder 1¼in. external diameter.

The superheaters are of the hairpin type, with solid forged cylindrical headers. The ends of the headers are solid with the barrels and thickened portions are left in way of mountings to avoid pads. Plate baffles are fitted in the headers to give double flow.

The tubes, which are 1¼in. external diameter, and of low carbon steel, lie horizontally in the nest of generating tubes, the headers being parallel to the fronts of the boilers. Suitable supports of "Era" steel are fitted in the boilers to carry the superheaters. This type of superheater has proved very successful and was fitted to H.M.S. "Meteor" and "Mastiff" as far back as 1914.

The space in the vessel allocated to these boilers being very restricted and lightness an essential feature, the air heating arrangements consequently had to be kept small and compact. The bulk of the heating surface of the air heaters is made up of tubular heaters, but a variation from the usual type with cylindrical tubes has been made by stream-lining the tubes to reduce the space occupied and the air pressure across the heaters as much as possible. The casings also have been utilised to preheat the air, which, after leaving the heater tubes, is led across them.

Before finally deciding on the type of heater to be fitted, experiments were carried out, space available, &c., being taken into consideration, and it was decided that the stream-lined tube type best met the case.

To offset, as far as possible, the increase in air pressure necessitated by air heaters, in addition to stream-lining the heater tubes, as previously mentioned, the combustion tubes were specially designed, and it is estimated that the total drop of air pressure from stokehold to funnel will be in the region of 4½in. to 5in. at full power, *i.e.*, burning over 1 lb. of oil per square foot of heating surface per hour. This figure compares with 5½in. to 6in. with the old type of combustion tubes without air heaters.

Cockburns' safety valves of the full bore type are fitted for saturated and superheated steam, the latter being set to lift at a slightly lower pressure than the saturated valves, to ensure a flow of steam through the superheater tubes. The water gauge fittings are of Dewrance and Wall type, screw-down valves being fitted. The feed regulator is of the Contrafio type supplied by Weirs.

These boilers are being built by John I. Thornycroft and Co., Ltd., to the order of the Parsons Marine Steam Turbine Company, Ltd., and are to supply steam to turbines being built by the latter company.

FOR the second time in a month a train has been blown off the line in India. The latest accident happened at Himatnagar.

Canadian Engineering News.

(From our own Correspondent.)

Use of Pyrites.

THE sulphur consumed in Canadian pulp mills and acid plants is worth approximately 3,000,000 dollars annually, and amounts to 150,000 long tons. The sulphur is imported from the United States, mostly from Texas, and while the price of newsprint has declined, the price of sulphur has advanced. Large pyrites deposits containing a high percentage of sulphur are situated within a reasonable distance of most of the Canadian pulp mills, and for the past few years commercial scale experiments have been conducted by Horace Freeman, chemical and metallurgical engineer, of Shawinigan, Quebec, with the object of introducing the native raw material into the Canadian pulp industry.

Mr. Freeman having devised methods of burning pyrites to make sulphur dioxide gas economically for use in pulp mills at Shawinigan demonstrated in early tests the feasibility of using sulphide concentrates as powdered fuel, and of preparing sulphur dioxide in suitable concentration for use in pulp and acid manufacture. Accordingly, the Sulphide Research Corporation arranged to install a commercial unit capable of burning 20 tons of pyrites per day at the St. Maurice mill of the Canada Power and Paper Corporation, and at that unit concentrates from the Britannia mine in British Columbia, assaying 50 per cent. sulphur, have been successfully treated. The fine pyrites and preheated air are driven by a fan into the furnace, where the pyrites particles are rapidly decomposed at high temperature. The products pass then into a second combustion chamber, where the sulphur is completely oxidised. The gases are then rapidly cooled in a fire-tube boiler which generates high-pressure steam; 1 lb. of steam is obtained from burning 1 lb. of pyrites and that covers the cost of operating. The gases produced contain 11 to 12 per cent. of sulphur dioxide. The residue of iron oxide can be utilised by sintering it. Mr. Freeman's process utilises the heat of combustion as well as the gas produced and the residue from burning the pyrites.

Overseas Tests of Ontario Coal.

Recent reference in the Ontario Legislature to the new lignite coalfield at Blacksmith Rapids, in Northern Ontario, drew from the Minister of Mines the interesting information that with an abundance of supply pretty well determined, the Government intends to seek the co-operation of experts in both England and Germany to establish the value of the coal's by-products. Sufficient quantities of the lignite have already been mined by the Government to permit overseas test shipments. It is also the intention of the Government to send several carloads of the fuel to the Western Provinces for trial, and also to try it as industrial fuel at Niagara Falls and other points in Ontario.

The Consolidated Mining and Smelting Company.

Production of metals by the Consolidated Mining and Smelting Company of Canada, Ltd., was well maintained during the past year, according to the company's annual report. A feature of the statement is the growing production of cadmium, which is becoming an important item in the company's wide range of products from the extensive metallurgical plant at Trail, British Columbia. It is also noted that the production of bismuth on a commercial scale began during 1929 and the sulphuric acid product is finding a market. With a reference to the fertiliser industry now under construction at Trail, the president, Mr. J. J. Warren, states that the directors have authorised the construction of an additional sulphuric acid plant with a daily capacity of 335 tons and the first unit of an ammonia plant with a daily capacity of 47 tons, at an estimated cost of 7,500,000 dollars. With reference to the Sullivan mine, the company's major mining property, which year after year turns out vast quantities of metals, the president states that it continues to develop favourably, and that notwithstanding heavy extraction, has maintained the quantity of ore reserves. The development of markets for fertilisers is touched on in the statement of Mr. Warren that further large-scale experiments and demonstrations were made on the Canadian prairie with superphosphate. He states that these experiments were quite successful, except where weather conditions ruined the crop, and that still further and larger demonstrations will be made during the coming season in anticipation of the distribution of fertiliser products in 1931.

Sodium Sulphate.

Large-scale mining of at least one of the Province of Saskatchewan's many deposits of sodium sulphate appears to be imminent. This is the operation of the Horseshoe Lake Mining Company, near Ormiston, about 75 miles south-west of Regina, in which the Barium Reduction Corporation of Charleston, West Virginia, and the International Nickel Company of Canada are financially interested. A large number of men is at present employed on construction work, and the plant being erected will cost close to 500,000 dollars. Railway tracks are now being laid out on the deposit, which is 30ft. thick at the centre and contains at least 9,000,000 tons of the natural crystals, according to information given by the manager of the Horseshoe Lake Mining Company. The sodium sulphate will be excavated by steam shovels. The plant, which will remove small percentages of mud, includes rotary steam drying or dehydrating equipment. The sodium sulphate deposits of Saskatchewan have been known for many years, and as a result of examinations conducted by the Federal Department of Mines, it has been established that they contain well over 100,000,000 tons of the natural hydrous salt. These deposits have been looked on as of great potential value, not only to meet commercial requirements in Canada, but because of the possibility of developing important export markets. One of the important uses in Canada is found in the pulp and paper industry, in which large tonnages of the anhydrous sodium sulphate are used in the production of sulphate or kraft pulp.

Extension to Vancouver Port.

The expenditure of 2,200,000 dollars to provide an additional storage for 5,500,000 bushels of grain in the port of Vancouver, and the construction of new port facilities at an esitmated cost of 5,000,000 dollars, has been planned by the Vancouver Harbour Board. Work on additional storage space at public elevators is to be expedited so that the facilities may be ready for the new crop in the autumn. These additions will give the port a storage capacity of 19,885,000 bushels and will place it ahead of Montreal in facilities. A new pier will be built and will be operated in conjunction with a new cold storage plant, which will be erected adjacent to the pier.

Montreal Terminal Project.

Work is now actively proceeding on the huge Montreal terminus project of the Canadian National Railways, which is one of the largest construction programmes ever initiated in the Dominion. When the plans were submitted to Parliament last year the cost was then estimated at 51,409,000 dollars for the entire terminal facilities to be laid down on the island of Montreal, including a large modern terminus on the site of the present Tunnel Station, and much work in other sections of Montreal in the revision of existing railway lines and construction of new trackage. At present men are at work in the south-west part of the city preparing for the construction of a subway, the first of six subways to be built at an estimated cost of 2,500,000 dollars. Concurrently

with the construction of these subways, work will be started this year on the main portion of the scheme—that is, the Central Station itself and the new railway line linking it with the Victoria bridge over the St. Lawrence River. The whole process of co-ordination as planned by the Canadian National engineers will involve the construction of more than 17 miles of new railway necessary to connect existing lines and bring about the economies in operation desired. The programme is to be proceeded with steadily, but in such a way as to cause the least interference and delays to existing traffic.

Coal.

The incorporation in British Columbia of the 10,000,000 dollar Coal and Iron Company, Ltd., is expected greatly to accelerate the development of Vancouver Island's rich coal resources. The plans of the company embrace a wide field of operation. It not only intends immediately to operate the Morden mine, but will enter into extensive experiments in the manufacture of coal by-products. The company has also acquired large holdings on the island for reserve purposes. It owns the interests and coal claims of the Consumers Coal Mines, Ltd., and of the West Coast Collieries, Ltd., which is a holding concern, together with the coal areas of both these companies at Suquash, on the north coast of Vancouver Island, amounting to 2600 acres, and the Round Island measures, near Nanaimo, 2786 acres. The greater part of the Round Island property is beneath the waters of the Georgian Gulf.

DIPLOMA FOR SPECIAL LIBRARIANS.

DURING the last decade or two there has been a rapid growth in the number of what are called "Special Libraries." Many of these are not libraries in the ordinary sense, but consist largely of such *abiblia*—to use Charles Lamb's term—as periodicals and other records of the latest research. Thousands of such periodicals are now coming in from every quarter of the globe, and the digesting and indexing of these requires scientific and technical knowledge and familiarity with many languages. Special libraries are an important organ in the research departments and information bureaux attached to the large technical and industrial corporations and also to the great scientific and other learned societies. To train competent librarians to run them is an urgent problem, which has been anxiously considered by "ASLIB" (Association of Special Libraries and Information Bureaux) and also by the School of Librarianship at University College, London.

The School of Librarianship has just prepared a scheme which has been passed by the Senate of the University of London to enable graduates in Science to receive a suitable course of training in one session, and attain the Diploma of Librarianship on conditions similar to those allowed to other University graduates.

The present curriculum stands good for every type of librarian, but certain alternatives have now been introduced for the benefit of those who wish to become special librarians. The separate subjects Library Organisation and Library Routine have been modified and combined into the new subject Library Economy (omitting those features peculiar to Public Library administration). The History of Science is given as an alternative to Palæography and Archives, and a new subject Special Library Services dealing with the point of view and the scope of special libraries and information bureaux has been introduced.

These Regulations come into force at once, and a course of instruction is being provided for the session beginning in October, 1930, when the new courses will start, provided that a fair number of persons desiring to train for work in special libraries enrol themselves before the middle of July. Further information can be obtained from the Secretary, University College London (Gower-street, W.C. 1).

THE INSTITUTION OF ELECTRICAL ENGINEERS—AWARDS OF PREMIUMS, &C.—The Council of the Institution of Electrical Engineers has awarded the following premiums for Meter and Instrument Section papers and also for students' papers for the session 1929–30:—*Meter and Instrument Section Premiums:* Silvanus Thompson Premium to Messrs. E. H. Rayner, W. G. Standring, R. Davis, and G. W. Bowdler. A Premium to Messrs. A. E. Moore and W. T. Slater. *Students' Premiums* to Messrs. E. W. Connon, J. C. Emerson and J. W. Moffatt, Dr. L. E. C. Hughes, and Messrs. C. S. T. Paul, W. G. Thompson, C. H. Bradbury, and S. M. Lejeune. *The Students' Prize, Session* 1929–30.—The Students' Prize of £10 offered by the Council for the best paper on the subject of "The Relations between Economics and Engineering" submitted by a student or graduate under the age of 28 during the session 1929–30 has been awarded jointly to Mr. V. A. H. Clements and Mr. A. K. Robinson for the papers submitted by them, the amount of the prize being divided equally between these two authors.

THE MICROSCOPICAL SOCIETY OF WALES.—The Microscopical Society of Wales, which came into existence on May 21st last, held its initial meeting at the Technical College, Cardiff, on June 4th, when the rules of the Society were formally sanctioned and the executive appointed. The objects of the Society are the promotion of microscopical science in all its branches by the communication, discussion, and publication of observations and discoveries relating to (1) improvements in the construction of the microscope and its accessories; (2) instruction in and improvements upon the manipulation of all instruments connected with microscopy; (3) the preparation of objects for microscopical examination; (4) the formation of a library, a collection of microscopes and microscopical accessories, and a cabinet of microscopical and lantern slides. The Society will consist of (*a*) ordinary members, (*b*) associate members, (*c*) corresponding members, and (*d*) honorary members, without distinction of sex. Further particulars may be obtained from the Secretary, Mr. Alfred E. Harris, F.R.M.S., 27, Park-place, Cardiff.

WHAT DOES WELFARE COST THE EMPLOYER?—Welfare need not be a costly item of management, for about nine-tenths of the activities covered by it are practically chargeless. Accident prevention, suggestion schemes, works and welfare committees, lectures and debates—none of these involve any capital expenditure, while other activities, such as tool, kit, and holiday funds, social clubs, camp and convalescent schemes, and dental schemes, can be made self-supporting. But there are, of course, some items which must be debited to the welfare account, and this question is discussed in detail in a confidential memorandum on "The Introduction of a Works Welfare Scheme," which has been compiled by special request for the use of member firms of the Industrial Welfare Society. A case is quoted in the pamphlet of an engineering firm with 700 employees, spending £648 on its welfare scheme, which represents less than £1 per employee per year. It is suggested that to a firm with 4000 employees, the allocation of a penny per day per worker would mean a fund of over £5000 per annum, and this figure would be sufficient to cover the salaries of the welfare staff and groundsman and the firm's contributions to the various benevolent funds.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

THIS week has witnessed fairly general resumption of activity at Midland and Staffordshire works, but, unfortunately, with obscure prospects in most cases. The general trade outlook has not improved since the holidays, and business is slow all round. In the iron and steel trades stocks are increasing in spite of the curtailment of output, and careful inquiries have failed to reveal any noticeable prospect of reinforcement of demand. In few, if any, of the consuming industries do manufacturers speak with confidence of the immediate future. Here and there, there are reasonably bright spots, but they do not count for a great deal, even when taken as a whole. Unemployment in this district is very bad, and taking Birmingham as an example the total of roughly 37,000 is some 16,000 higher than in the corresponding period last year. The boycott of British goods in India, and the difficulties of trading with Australia have very seriously affected many Midland and Staffordshire industries, and markets to fill their places are difficult indeed to secure. It is hoped, but with little confidence, that the trade depression in this district has reached its worst.

Staffordshire Bar Iron.

Production of Staffordshire bar iron is maintained at recent levels, but hopes recently expressed of reinvigoration of demand have not so far materialised. In the marked bar department, business is such that ironmasters have no immediate cause for concern. Orders come in with regularity and order books are just about balanced, work coming in being equivalent to work going out. There is no difficulty in this branch of the iron trade in maintaining prices, and best grade bars command £12 10s. per ton. Competition is keen for all business in the Crown bar department, resulting in a wide variation in prices. In Staffordshire, the recognised minimum is £10 per ton, but many ironmasters want £10 7s. 6d., which is considered the economic price level. The figure of £10 per ton is said to be quite unremunerative, production costs being high. Makers from other districts who can sell at below this figure secure a good deal of the available business. Common bar iron is quoted from £9 to £9 5s. per ton, but as Belgian No. 3 iron, used for similar purposes, is obtainable at under £6 per ton, it is not to be wondered at that local makers secure a very small percentage of the orders coming on to the market. There appears to be a good deal of cutting going on amongst merchants dealing in this class of material. They are all anxious to get what orders are going in the present dull state of trade. Producers of wrought iron strip are fairly engaged, though they could handle more work. They uphold their selling price at £11 2s. 6d. per ton.

Steel.

Forward contracting for structural steel is virtually at a standstill; moreover, local steel mills continue to experience difficulty in getting specifications against commitments entered into some time ago when the outlook appeared more favourable. Midland constructional engineering firms are but poorly supplied with orders, and the orders they have to give out for requirements as they arise are small. Building contracts account for a moderate amount of steel, but there is little inquiry for bridge work and undertakings such as are the backbone of constructional engineering. Finished steel prices are unaltered, but they are likely to come under review in the near future. There is no change of moment in the half-products branch. Business is still unsatisfactory and continental competition is keen. Native billets are on a minimum of £6 per ton, small steel bars £8 per ton, while steel strip varies from £8 to £8 10s. Continental prices are irregular, but the general quotation this week for bars was £6 9s. 6d. delivered, billets £5 12s. and strip £6 17s. 6d. The control of the cartel appears to have broken down somewhat, for, in one way or another, merchants are able to "cut" the official prices. There is no great volume of business being done in either native or foreign steel, however.

Pig Iron.

There is no change in the pig iron situation on the week. Foundrymen are buying no more than of late, being satisfied that there are sufficient stocks at the furnaces to meet any emergency which may arise. At date, however, prospects alike at the forges and foundries give no sign of improvement. Consumers of pig iron, still vexed with producers for failing to grant them relief in prices, continue to buy on a hand-to-mouth basis. They would not do otherwise, even could they see well ahead, they assert. It is the only method left open to them of registering their protest at the maintenance of selling prices regardless of recent decreases in production costs. The solidarity of quotations is maintained, Northamptonshire No. 3 foundry being £3 15s.; forge, £3 11s.; Derbyshire foundry, £3 18s. 6d.; forge, £3 14s. 6d.—all per ton, delivered stations in the Black Country. The furnace coke position is unaltered; supply is, if anything, in excess of demand.

Galvanised Sheets.

The galvanised sheet market in the Midlands is much as it was a week ago. Consumptive requirements are below normal, and mills are only kept going with difficulty. Demand from home quarters keeps up, but overseas orders are small and irregular. Galvanised sheet of 24 gauge are maintained at £11 17s. 6d. per ton f.o.b. Liverpool.

Scrap.

There was no improvement in the demand for steel scrap, and both Midland and South Wales consuming works are now refusing further deliveries. Values are precarious, and in many circles are considered not yet to have reached bottom. Birmingham merchants quote as a week ago. There are no buyers.

Production.

As was anticipated by Midland iron and steel masters, the statistics of production for the month of May reveal a general decline. In the raw iron department, however, it is more than accounted for by the curtailment of production, ten blast-furnaces having been put out of action during the month, making the number of active furnaces at date 141. The 614,500 tons of pig iron produced compare with 619,600 tons in the previous month and 654,800 tons in May, 1929, giving a daily rate of output of 19,823 tons. The foundry iron produced totalled 130,700 tons, forge 23,600 tons, hematite 187,700 tons and basic 248,300 tons. Steel ingots and castings produced in May amounted to 692,800 tons, as against 696,100 tons in April, and showed a big decline on the output of 843,800 tons in May, 1929.

Lower Exports.

Midland industrialists, and in particular iron and steel manufacturers, regret to learn that during the first five months of this year the value of the exports of iron and steel was lower by £4,744,920 than during the corresponding period last year, and that there was a fall of no less than £40,827,875 in the value of articles wholly or mainly manufactured sent abroad. During the month of May alone, iron and steel manufactures were £1,772,973 below last May's exports, while articles wholly or mainly manufactured showed a drop of £13,582,265 when compared with the same month a year ago.

Coventry Industries.

I am happy to be able to report a decided improvement in the artificial silk industry. All the spinning factories in Coventry are now working fully, and thousands of hands who for a lengthy period have been on short time are now able to earn full wages. Although inquiries are improved in the textile trade, business is dull in most sections. The automobile industry is not working up to capacity. Most of the light car firms could do with more business. It is considered that the selling season will be short, and the year a far from satisfactory one. The machine tool trade keeps up well, and prospects are reasonably bright.

Obituary.

The death last week of Mr. Harry Lench, head of the firm of T. W. Lench, Ltd., nut and bolt manufacturers of Excelsior Works, Blackheath, removes a well-known figure from the Birmingham Iron and Steel Exchange. Mr. Lench, who was sixty-two years of age, was largely responsible for the enormous growth of the firm, the business to-day being one of the largest of its kind in the Midlands, employing some 2000 hands. Another well-known and highly respected member of the Exchange in the person of Mr. E. J. Chambers, chairman of H. and T. Danks, Ltd., of Netherton, died last week. Mr. Chambers, who was eighty-six, was for many years managing director of Bullers, Ltd., of Tipton, retiring in 1904, after which he became associated with Messrs. Danks, boilermakers, a connection maintained until the time of his death.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Textile Machinery Exports on Bigger Scale.

SHIPMENTS of British textile machinery last month made an appreciably better showing than in April, although the total value was much below that of May of each of the two previous years, and altogether on the five-month period there has been a decline to £4,064,890 from £5,015,721 in 1929 and £4,882,289 in 1928. Shipments during the month under review amounted to 8479 tons, valued at £830,927, against 13,374 tons, and £1,195,479 in May, 1929, and 9356 tons and £925,861 in 1928. Compared with a year ago, the decline has been general in respect of all markets and more especially Japan and continental countries. British India, however, continues to occupy a leading position, shipments thence during the past month reaching a total value of £261,394. Russia is in the second place with £76,731, followed by France, £74,018; China, £72,062; the United States, £43,102; Japan, £34,773; the Netherlands, £30,809; Germany, £21,265; South America, £19,018, and Australia, £19,207, exports to "other continental countries" being valued at £129,339. These figures relate to spinning and twisting machinery. In addition, there were shipments of weaving machinery to an aggregate value of £106,491, and of miscellaneous textile plant to the value of just over £70,000.

Industrial Conditions.

In the course of its monthly survey of general industrial conditions in this area the Manchester Chamber of Commerce comments as follows on the state of the engineering trades:—"Engineering firms as a whole have been rather less successful than in recent months. Leading electrical firms have been generally well engaged, but some of the others have been short of orders. That has also been the experience of the constructional section. Commercial motor vehicles have been in good demand and the prospects in the immediate future also are considered good. Textile machinists, however, have had a lean time, loom makers especially having had little work. Indian mills are thought likely to increase their machinery in the near future, but the unrest in the country has prevented much being done lately. Locomotive builders have had some good orders in hand, but colliery engineers and boilermakers have had little to do. The activity of recent months in the machine tool trade has eased off, but trade gear cutters have been moderately well engaged."

The Financial Side.

In contrast to a good many recent balance sheets issued by Lancashire engineering firms, increased profits are shown in the accounts just published by Hick, Hargreaves and Co., Ltd., Soho Ironworks, Bolton, for the twelve months to March 31st. A year ago, the net profits, after providing for debenture interest, depreciation and other charges, and including the amount brought forward, were £11,445, and a dividend of 2½ per cent. was paid. For the last financial year the distribution has been raised to 3 per cent., the profits having increased to £15,110. The value of the year's contracts was higher than in 1928–29, and the directors also state that the value of uncompleted work is also rather greater than it was twelve months ago. An interesting financial statement is that of Manchester Collieries, Ltd., which was formed early last year as the result of an amalgamation of a number of leading coal-mining concerns in the area. After providing for amortisation of fixed assets and for the depreciation of rolling stock, the disposable profit for the period from March 12th of last year to March 31st, 1930, amounted to £108,215, and after providing for a dividend of 7 per cent. on the preference shares the sum of £17,568 is carried forward.

Non-ferrous Metals.

The non-ferrous metals market in all sections has had another depressing week and low records go steadily by the board as fresh breaks in prices occur. Statistically, the position of the leading metals continues definitely bearish and the knowledge of this makes its influence felt on buying operations. Output restriction talk is much in the air, but until consumers see it actually reflected in reduced offers a turn in the tide of price movements and a re-establishment of confidence are unlikely. The extent to which confidence is lacking may be inferred from the fact that in virtually every section of the market buyers for industrial purposes, notwithstanding the undeniably low levels to which the metals have fallen, are doing little more at the present time than meet early needs. Compared with a week ago, the standard copper market has lost heavily and the prices now current are roughly 30s. a ton below the previous "low" touched at the beginning of last month, whilst a fresh reduction in electrolytic metal has been announced by the American export combine. The decline has been relatively less severe in the case of tin, but nevertheless in this section, as well as in both spelter and lead, the markets have been unable to resist the further depressing influences.

Iron and Steel.

More activity has been in evidence on the iron and steel markets here than during Whitsun week, but owing to extended stoppages many consuming works have been slow in getting back into stride, and deliveries generally have been below the level of a fortnight ago. Unfortunately, there is no indication of improvement either in the Lancashire foundries or at the steel-consuming end, and sellers are not looking for any immediate expansion in the rate at which their products have been taken recently. The demand for foundry iron is still limited to early delivery transactions, although quotations are held at 77s. per ton for Staffordshire and Derbyshire makes, about 94s. for Scottish, and up to 90s. per ton for West Coast brands of hematite iron, all for delivery equal to Manchester. Bar iron needs are easily met and sales during the past few days have been extremely slow. Lancashire Crown quality bars are quoted at £10 5s. per ton and No. 2 material at about £8 15s. In odd cases, there have been additions to the order books of local constructional engineers, but most firms in this branch could easily tackle a good deal more work than is at present available, but there is a paucity of inquiry about which does not promise well for the next month or two. Steel buying generally on this market is at a low ebb and the majority of rollers complain bitterly of the absence of support which they are getting from Lancashire engineers.

BARROW-IN-FURNESS.

Hematite.

There is no improvement to report regarding the West Coast hematite pig iron trade. Business has not improved up to the present, but the real test will come next month when many orders for forward delivery will have been completed. There is a tendency for stocks to increase at some works. It is not known how the reductions in the price of iron abroad will affect local markets, but it is thought by some that the present trade will continue inasmuch as the great bulk of the pig iron which is shipped to the Continent is of a special quality. It is too early to form any opinion yet as regards the reduction in price of 5s. If ship plates were being produced in this district it would be a different thing. Iron ore is unchanged, but the outlook is not so bright. As regards steel, the market is dull and the competition for orders is keen. Neither of the local steel works is well fixed for contracts. New orders would be most welcome.

Shipbuilding.

The Isle of Man Steam Packet Company's new steamer "Lady of Mann" left Barrow last week-end for her trials. She is designed for a speed of 21 knots, but this has been exceeded by 2 knots on the trials. She has 4ft. more beam than the "Ben My Chree." This extra beam will lessen the draught and enable her to enter Fleetwood at all states of the tide. The twin-screw passenger steamer "Mayon," for Duff and Company, Glasgow, will be launched on the 26th.

SHEFFIELD.

(From our own Correspondent.)

Depression Deepening.

BUYING and selling of steel and steel material are still under the influence of the Whitsuntide stoppage, and consequently there is little change to report in the trade situation. Neither is there any sign of a change impending, though one is greatly needed, to relieve the depression, which is now affecting almost every section of local industry. Speaking generally, conditions are worse than they have been for some years, and that is true of the lighter as well as of the heavier branches. Sheffield is not alone in this respect; in fact, it is probably holding its own as well as most places, for all the great centres of industry appear to be badly affected, and some of the competitive countries are worse off than ourselves. The difficulties of Germany are evidenced by the recent reductions in prices, which, of course, will make competition with them all the harder. At the moment, the number of local furnaces standing idle forms a majority of the whole. The production of steel ingots and castings in this area during April showed a fall of no less than 26,000 tons, as compared with March. The total, 86,800 tons, included 35,300 tons of acid and 45,400 tons of basic. The Lincolnshire steel trade, which up to recently was very busily employed, is now experiencing a marked shortage of new business. The production of pig iron is also falling off. A report from that district states that a blast-furnace was put out at the week-end at the Frodingham Iron and Steel Works. Earlier in the year one was stopped at the Appleby works.

The Brighter Side.

There is, however, a much more favourable way of viewing Sheffield's position, and the Master Cutler (Mr. A. K. Wilson) and the President of the Chamber of Commerce (Mr. R. W. Matthews) have taken steps to present this view to the world. Sheffield is far from being "down and out," and the present depression of its industries is, after all, a matter of comparison. Statements to the detriment of Sheffield have been circulated in many quarters, and the Master Cutler and the President of the Chamber are doing their best to combat them by means of an important letter which they have addressed to British consular officers throughout the world. "Sheffield and her products," they say, "have been so systematically maligned by interested parties during a long period of years that her prestige, her productive capacity, and her efficiency have been totally misunderstood, and therefore underrated, particularly in countries outside the British Empire." They go on to emphasise the striking facts that Sheffield is now turning out annually 50 per cent. more steel and steel products than in the best pre-war years; that she is employing many thousands more hands than before the war; that she has kept pace with her competitors in the production of high-grade steel; and that Sheffield steels to-day are not only vastly better than they have ever been, but are further ahead of the rest of the world than at any previous time. The only reason why she is not working to her present full capacity is because her capacity for output was trebled during the war period. With regard to the high unemployment in the city, which has been represented as a sign of decadence, they point out that since the end of the war Sheffield has absorbed into her own factories, working under peace conditions, no less than 75 per cent. of her extra war-time workers left after the Armistice. As showing the quality of Sheffield steels, they say that it is a significant fact that users in the United States of America are at the present time purchasing certain Sheffield steels at three or four times the price that they would have to pay to their own makers for the nearest American-made equivalent.

Special Departments.

The trade in various special lines of steel manufacture, although on a substantial scale, is below the average levels of the past few years. The automobile manufacturers of the country, although relieved of the fear that the McKenna Duties would be swept away by the Budget, have not yet resumed ordering on the customary scale such Sheffield products as forgings, pressings, and alloy steels for the parts subjected to the heaviest wear. J. J. Havershon and Sons, Ltd., of Rotherham, referring to this in their works magazine, say: "We are frankly disappointed that the removal of a threat to an industry which absorbs large quantities of our products has not given a greater stimulus to trade. We are convinced, however, that trade would be worse still if the duties had been repealed." Ambrose Shardlow and Co., Ltd., of Sheffield, in their annual report, refer to "the present unsatisfactory state of the motor and other industries as compared with a year ago." Sheffield continues to be called upon for special steels for aircraft construction, for motor boats, and for all other purposes in which excessive stresses have to be withstood.

Stainless Steel Furniture.

New uses are still being found for stainless, non-corrodible, and heat-resisting steels, for which there is a substantial demand, although here, again, the effect of the prevailing bad trade is being felt. Attention has recently been called to German steel furniture, and the statement made that Sheffield had done nothing to create a home market for this commodity. This is far from being correct, however. Thos. Firth and Sons, Ltd., the well-known manufacturers of stainless steel, state that they have produced a considerable amount for use in furniture, supplying it in sheets to the actual furniture manufacturers, who are able to deal with it to provide ornamental effects and designs. It has been used for office equipment and the furnishing of restaurants, and some of the other uses to which it is being put at the present time are all-metal furniture, more particularly for offices and school use, such as desks and chairs, the latter being constructed of polished stainless tubes; table legs and pedestals, coal scuttles and similar articles; piano fittings, such as pedal mechanism, hinges, music racks lighting brackets, and decorative work; cabinet fittings, such as hinges, handles, lock accessories, and scutcheon plates; bathroom and lavatory fittings, including taps, steel mirrors, and mirror frames, shelf brackets, brush and glass holders, and general metal equipment.

Shipbuilding Orders.

The satisfaction recently caused in Sheffield by the announcement that John Brown and Co. are to build the great new Cunarder has been increased by the report that the Admiralty has given orders to Vickers-Armstrongs for the building of two destroyers, the "Cygnet" and the "Crescent," and also for the machinery for the cruiser "Leander," which is being built at Devonport. Vickers-Armstrongs have also booked an order from the Great Western Railway Company for a 30-ton hydraulic movable coaling hoist, complete with high and low-level traversers, for the company's North Dock, Newport, Mon.

A Coal Discovery.

After several months of drifting, the New Silkstone seam of coal has been struck at Mitchell Main Colliery, near Barnsley. This seam, which lies deep below the Parkgate, ranks high as a steam coal. Its usual thickness is about 4ft. It is won at the neighbouring collieries of Barrow and Cortonwood, but has never hitherto been worked at Mitchell Main. It is described as of useful thickness, and the discovery is expected to lead to considerable developments of the colliery.

The Cost of Humber Bridge.

Discussions are proceeding with regard to the apportionment of the cost of building the proposed great bridge over the Humber near Hull, at a total outlay of £1,750,000. At a conference of public representatives from Yorkshire and Lincolnshire, held at Hull last week, the Lord Mayor of that city said that there were hopes that the Government would contribute 75 per cent. of the total, representing £1,350,000, but that it was not prepared to "show its hand" till it knew what value the local authorities most concerned were prepared to place upon the proposal. The Hull delegates said that they were recommending their City Council to contribute £200,000, and the Lord Mayor suggested that the County Councils of the East Riding and of Lindsey should each be asked to contribute £50,000, and that the balance of about £100,000 should be raised by toll, unless the Government was sufficiently generous to make tolls unnecessary. Lord Deramore, chairman of the East Riding County Council, did not hold out any hope of a contribution from that body. He said that already there was a feeling among rural ratepayers that they were contributing towards the upkeep of roads for the benefit of people in the towns. In reply, Hull representatives urged that the areas outside Hull were most likely to benefit by the opening of the bridge, because industry was having to find sites out of the cities, and was increasing the rateable value of county areas. The conference decided to ask the authorities represented to give immediate consideration to and report on the amount they will be prepared to contribute.

Cutlery and Plate.

The cutlery and plate trades remain in much the same state as recently reported. There is only a slow demand from distributors who do the ordinary over-the-counter trade in this country, and the export demand shows a falling off in several markets. At the same time, the output of stainless table cutlery is large, and there are some good contracts on hand for tableware equipment for ships and hotels. A steady business is done in best pen and pocket cutlery. The scissors branch maintains its activity, and there is a large production of safety razor blades. Several Sheffield firms are now making blades to sell at a penny each, and consider that there is a market for them as well as for the more expensive qualities. Blades to sell at a penny were first supplied by Germany, and, in view of the fact that they have to pay an *ad valorem* duty of 33⅓ per cent., in addition to freights and a series of profits, it is difficult to see how they can be made profitably.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Shipbuilding Industry.

THE shipbuilding industry on the North-East Coast is experiencing another very quiet period so far as new work is concerned. Some of the yards are viewing the future with some anxiety. Since Smith's Dock Company booked the nine whalers recorded last month, only two orders have come to the district, one for an oil tanker, which has been placed with Sir James Laing and Sons, Sunderland, and the other for a steam collier to be built by S. P. Austin and Son, Sunderland. Not a few of the yards are running short of work, but some establishments are fortunate in having employment assured to the end of the year. Among them are Swan, Hunter and Wigham Richardson, Ltd., Wallsend; Sir W. G. Armstrong, Whitworth, Ltd., Walker, and J. Doxford and Sons, Ltd., Sunderland. In each case tanker prospects are mainly responsible for the fortunate position. Last year the conversion of large liners into whaling factories was a prominent feature in the shipbuilding work on the Tyne and Tees. More work of this kind would be extremely welcome just now.

Cleveland Iron Trade.

The Cleveland pig iron trade presents no new features. The output is so severely restricted that not much comes on to the market, but only for this reason has it been possible to avoid a heavy increase in the stocks, as the current demand is exceedingly small. Still, buyers are very backward. Ironmasters adhere to their fixed minimum prices, No. 1 Cleveland foundry iron being 70s., No. 3 G.M.B. 67s. 6d., No. 4 foundry 66s. 6d., and No. 4 forge 66s.

Hematite Pig Iron.

Deliveries of East Coast hematite pig iron against running contracts are fairly good, but new orders are few and small. Overseas customers are largely using comparatively cheap continental makes, while home consumers are making only light purchases. Terms of sale vary a good deal after individual bargaining, and orders are unobtainable except at substantial loss to manufacturers, who have to contend with price-cutting by merchants. Ordinary mixed numbers are offered freely at 72s. 6d. No. 1 quality is at a premium of 6d. per ton.

Ironmaking Materials.

The futility of attempting to put through new business in foreign ore under existing conditions is fully realised, and prices are quite nominal. Durham blast-furnace coke is abundant and difficult to dispose of. Makers are pressing sales at the equivalent of good average qualities at 17s., delivered to works in this district, but consumers claim that they can readily satisfy their needs on lower terms.

Manufactured Iron and Steel.

The announcement of a reduction of steel prices in Germany has been much discussed in this district, and is likely to have some influence on the meeting to be held in London to consider revision of fixed prices of British steel. Outputs have not yet been seriously reduced, but orders are being worked off at a rapid rate and new contracts have been coming along very slowly.

More Works Closing.

Notices have been posted at the Ayresome Ironworks of Gjers, Mills and Co., Ltd., Middlesbrough, intimating that the men are on a week's notice. No decision to close down the works has been taken, but the men will continue after this week on day-to-day notice. If accumulated stocks can be disposed of it is hoped that the notices will not be put into effect. The works have been closed down several times in recent years. As already announced, the Dinsdale Works of the Linthorpe Smelting Company, Ltd., will be closed down shortly. If both stoppages occur the only two remaining independent ironmaking firms in the North-East will be out of action.

The Coal Trade.

The Northern coal trade does not show any encouraging sign, and, in fact, the recent depressing outlook is more pronounced. The demand from contractors is more meagre and there is no counterbalancing of the position by any new business. There still seems a doubt whether minimum prices will be adopted in Durham. They have obtained in Northumberland for the last three months. Individual collieries may make no further concessions, but may stop when there is no trade. It is a policy more or less in vogue at the present time. In Northumberland minimum prices are less difficult to maintain in respect of large than of small coals, which are now abundant and, in some instances, have had to be stored on the ground for want of trade. Even with short time working the surplus has been considerable. There is much lost time at the gas coal pits on account of the lack of orders, this being the dullest period of the year, apart from the acute depression in trade internationally. Northumberland best steams are easily obtainable at 13s. 6d. and smalls are offered at 10s. and through second-hands concessions are possible. Durham best steams are quiet and nominal at 15s. 6d. for large and 12s. 6d. for small. The consumption of Durham coal appears to be far below previous years' experience. Best gas coal is quoted at 15s. 6d., secondary 13s. 3d., and prime qualities 15s. 9d. Perhaps the best feature of the fuel market is the larger forward inquiry for patent foundry cokes for export. In Scandinavia the consumption for central heating is going up substantially. This is reflected in greater trade with this district and prices in the near future are likely to rule very firm. In this district, however, the outlook for the sale of blast-furnace coke for home use is very disappointing. The iron and steel industry is exceedingly quiet, the demand all over Europe is contracting and more ironstone miners are to be paid off. Blast-furnace coke is quoted at 17s., but users assert they can cover at less. The position of patent foundry coke for export is variable for prompt. Some makers of ordinary qualities are firmly standing out for 18s., but there are other sellers at 17s. to 17s. 3d. These prices are for early shipment. For forward delivery there does not appear to be anything under 18s. Higher qualities are steady at 20s. Beehive coke is in limited output and producers ask 24s. to 28s. Gas coke is the best feature of the section and sellers do not offer below 21s. 6d.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding Orders.

FOLLOWING on the order for the new Cunarder, announced last week, comes the promise of contracts for two liners for the P. and O. Company. Another contract which should provide work for a large number of men for several months has been placed with William Beardmore and Co., Ltd., Dalmuir. The latter provides for the construction and installation of exhaust steam turbines on the Bauer-Wach system in seven of the large vessels owned by the Clan Line.

Steel.

The market for steel continues quiet on both home and export account. So far as the home demand is concerned, the lack of specifications for shipbuilding materials has been a prominent feature, and though perhaps an early improvement cannot be hoped for, the position has altered for the better, in view of the contracts referred to above. There is no sign of any widening of the export demand, owing to unsettled conditions abroad—especially in India and Australia. One or two of the steel works are busy, but on the whole specifications are of a very hand-to-mouth description and of a limited tonnage. Makers of large tubes have good orders on hand, but there is only a restricted demand for butt-welded and lap-welded tubes of small diameter. The lighter gauges of black sheets have a steady turnover for home consumption, but the heavier descriptions are neglected. Galvanised sheets have a very poor market in the meantime.

Iron.

Makers of bar iron and re-rolled steel bars make little progress, and short time is prevalent. Prices are nominally unchanged, with the latter at £7 12s. 6d. per ton, home or export.

Pig Iron.

There is no sign of a broadening demand for pig iron. Makers have difficulty in disposing of the limited output, owing to keen competition, and the production will be further reduced, more especially as the prices obtainable are not considered remunerative. During the past week 1200 tons of pig iron from England were unloaded at Bowling.

Scrap.

Business in scrap has fallen off and merchants experience some difficulty in securing orders against contracts. Prices are weak, heavy steel being now quoted 52s. 6d. to 55s. 6d., cast iron machinery 65s., and heavy basic 56s. to 57s. per ton.

Coal.

The trend of business in the Scottish coal market is still disappointing. The lack of export orders becomes more pronounced, exporters being unable to make much headway against keen foreign competition. This is amply borne out by the fact that of the Swedish State Railways contract only some 2000 tons were placed in Scotland and some 176,000 tons in Poland. All descriptions of round coal show continued weakness, the only exception being first-class Fifeshire steams, and even these can be obtained below colliery quotations through second-hands. The small sizes of nuts are firm, owing to reduced supplies. Aggregate shipments amounted to 236,652 tons, against 259,341 tons in the preceding week and 248,001 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

IT is difficult to find any new feature in the steam coal trade of this district, and the quietness of the demand makes the conditions monotonous, not to say dull. Shipments last week were much below the average on account of the holidays and the fact also that tonnage at the disposal of the collieries was quite inadequate. According to the returns of the Great Western Railway Company coal exports came to 287,600 tons, which compared with 568,200 tons in the preceding week and with 601,173 tons for the corresponding week of last year, which was a normal working week. As usual, at the end of the week the number of idle tipping appliances was fairly heavy and came to 32, with only four steamers waiting to load. Tonnage arriving over the week-end was by no means plentiful, but the position on Tuesday was that the number of idle appliances was reduced to 28 and there were eight vessels waiting to load. As a matter of fact, chartering during the second half of last week was moderately active, thus giving rise to hopes that shipment activity during the next week or so will not be less than has recently been experienced, though it is too much to expect any real improvement, as fresh inquiries from abroad are still very limited. The volume of new business for prompt loading is very meagre, but looking ahead, the Buenos Aires Electricity Works have asked for prices for 100,000 tons of sized coals for delivery over 1931, and another inquiry is from the Lisbon Tramways for about 14,000 tons of coals for delivery during the second half of the year

Miners' Hours.

The South Wales Miners' Industrial Union recently took a ballot at the Kenfig Hill collieries on the question of a re-arrangement of hours in mines, the point put to the men being whether they were in favour of five days of eight hours and one day—Saturday—of five hours, providing an arrangement could be made with the colliery company to guarantee them work on Saturday, whenever possible, or to pay them adequate compensation for time lost. The results so far obtained show that the men are in favour of this arrangement instead of a rigid seven and a half hours, as laid down in the Government Bill, the figures being 374 for and 43 against.

Raglan Strike Unsettled.

Hopes were entertained last week that the strike which had lasted seven weeks at the Raglan Colliery, Heolyeyw, near Bridgend, would have been brought to an end, but the miners' agent reported to a mass meeting of the men on Friday last that the management had decided to make no variation as regards the conditions of employment from those which prevailed before the stoppage. The men, therefore, decided to remain on strike. The stoppage came about owing to a dispute regarding the yardage agreement. Whilst the men have been out they have been paid strike pay on unemployment rates by the South Wales Miners' Federation, and so far this is estimated to have cost well over £3000.

Trimmers and Tippers and Night Work.

It is more than a month ago since, following upon a ballot, the trimmers and tippers in this district authorised their respective unions to give immediate effect to their desire to revert to the system of continuous day shifts at the docks in South Wales, thus abolishing night work. As previously mentioned, all the employing interests are strongly opposed to such an alteration as being entirely inimical to the interests of the trade. There is, therefore, much speculation, not to say anxiety, as to what may be the outcome of a conference to take place at Cardiff on Wednesday of this week of representatives of the three unions concerned, viz., the Cardiff, Penarth and Barry Coal Trimmers' Union; the Transport and General Workers' Union, to which the Newport, Swansea and Port Talbot trimmers and tippers belong; and the National Union of Railwaymen, which is the organisation of which the Cardiff, Penarth and Barry tippers are members. The conference was to be attended by officials from the headquarters of these unions.

Record Steel Production.

The Cardiff-Dowlais steel works have just established a fresh record in the production of steel. It was in December, 1929, that the largest blast-furnace in the country was "blown in," and last week the output reached the record total of just over 4000 tons. To mark this achievement the flag was flown at No. 4 blast-furnace on Monday. These works are, of course, now under the control of the new company formed by Guest, Keen and Nettlefolds, Ltd., and Baldwins, Ltd., in connection with their scheme for the rationalisation of the steel industry. Another furnace at the same works previously held the record for a week's out-turn of 3700 tons.

Drainage Contract.

Last week the Swansea Corporation Drainage Committee accepted the tender of Barnes, Chaplin and Co., of Roath, Cardiff, for contract No. 6 in connection with the Fforestfach and Waunarlwydd drainage scheme. A grant towards the work is being received from the Unemployment Grants Committee. Tenders were received in two parts, Barnes, Chaplin and Co. quoting £37,603 for the work to be carried out without a change of men, or £41,385 if the men were changed every fortnight. In view of the state of unemployment, the Committee decided to accept the latter tender.

Swansea Docks Development.

Preparations for commencing the new alternative lock at the King's Dock, Swansea, are being proceeded with, and already boring operations on the site have been started. It is also officially stated that a very important scheme of development as affecting the Prince of Wales Dock and for dealing with the coal traffic is contemplated, though actual details are not so far disclosed. Mr. C. S. Page, the chief docks manager, met Mr. H. L. Wilkinson, the assistant superintendent of the G.W.R. Company, and local officials at Swansea last week, when the whole question was discussed. It is stated that the scheme involves taking over a portion of the old Rhondda and Swansea Bay Railway. Work of renewing coal hoists at this dock is also proceeding, and on Monday the second of the Hancock anti-coal breaking appliances arrived and will be fixed in due course.

Current Business.

The tone of the steam coal market in all its branches continues to be quiet. Supplies of most descriptions are readily obtainable at schedule prices, but owing to the numerous pit stoppages of late some sized qualities are on the short side. Coke and patent fuel meet with a moderate inquiry, while pitwood keeps about steady at 26s. to 26s. 6d.

LAUNCHES AND TRIAL TRIPS.

PEGASUS, motor tank ship; built by Wm. Doxford and Co., Ltd., to the order of Olson and Wright; dimensions, 480ft. by 65ft. by 36¼ft.; to carry 1400 tons. Engines, four-cylinder opposed-piston Diesel; trial trip, recently.

NINA BORTHEN, oil tank motor ship; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of Skibs A/S Motortank; dimensions, 408ft. by 54ft. 9in. by 32ft.; to carry 8950 tons. Engines, Armstrong-Sulzer two-stroke, single-acting, six-cylinder Diesel; constructed by Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd.; launch, May 28th.

BEAULIEU, oil tank motor ship; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd., to the order of Biorn Biornstad and Co.; dimensions, 408ft. by 54ft. 9in. by 32ft.; to carry 8950 tons. Engines, Armstrong-Sulzer two-stroke, single-acting, six-cylinder Diesel; constructed by Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd.; launch, May 29th.

CLAUGHTON, twin-screw passenger ferry steamship; built by Cammell Laird and Co., Ltd., to the order of the Corporation of Birkenhead; dimensions, 158ft. 6in. by 40ft. 11in. by 11ft. 9in. Engines, four-cylinder inverted triple-expansion, pressure 180 lb. per square inch; launch, May 29th.

EDWARD BLYDEN, motor ship; built by Harland and Wolff, Ltd., to the order of the British and African Navigation Company, Ltd.; dimensions, 370ft. by 51ft. 6in. by 33ft. 6in.; gross tonnage, 4022. Engine, single-acting, eight-cylinder, airless injection: trial trip, May 29th.

KOTA PINANG, motor ship; built by the Netherland Shipbuilding Company, Ltd., to the order of N.V. Rotterdam Lloyd; dimensions, 464¼ft. by 60½ft. by 33½ft.; to carry 9500 tons. Engines, 5200 S.H.P. Fyenoord-M.A.N.; trial trip, May 29th.

SILVERTEAK, motor ship; built by Harland and Wolff, Ltd., to the order of Stanley and John Thompson, Ltd.; dimensions, 455ft. by 61ft. 9in. by 40ft.; gross tonnage, 6200. Engines, two sets of single-acting Harland-B. and W. Diesel; constructed by the builders; launch, May 29th.

THURSTASTON, twin-screw passenger ferry steamship; built by Cammell Laird and Co., Ltd., to the order of the Corporation of Birkenhead; dimensions, 158ft. 6in. by 40ft. 11in. by 11ft. 9in. Engines, four-cylinder inverted triple-expansion, pressure 180 lb. per square inch; launch, May 29th.

JOHN P. PEDERSEN, oil tank motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Helmer, Staubo and Co.; dimensions, 432ft. by 58½ft. by 31½ft.; to carry 9000 tons. Engine, reversible single-acting, two-stroke cycle; constructed by Wallsend Slipway and Engineering Company, Ltd.; launch, May 30th.

MEDOC, steamship; built by David and William Henderson and Co., Ltd., to the order of Worms and Co.; dimensions, 236ft. by 34ft. by 16ft. 9in.; gross tonnage, 1200. Engines, triple-expansion, 18in., 30in. and 50in. diameter by 36in. stroke, pressure 200 lb. per square inch; constructed by the builders; launch, May 30th.

KIM, motor tank ship; built by Sir W. G. Armstrong, Whitworth and Co. (Shipbuilders), Ltd.; to the order of Mr. Sverre Sturlung; dimensions, 408ft. by 54ft. by 32ft.; to carry 8970 tons. Engine, Armstrong-Sulzer two-stroke single-acting six-cylinder Diesel; constructed by Sir W. G. Armstrong, Whitworth and Co. (Engineers), Ltd.; launch, June 10th.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 21/-
(1) Spanish	20/6 to 22/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	20/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 1 0	—
No. 1 Foundry	4 0 6	—
No. 3 Foundry	3 18 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 12 0	3 12 0
No. 1	3 12 6	3 12 6
Cleveland—		
No. 1	3 10 0	3 10 0
Silicous Iron	3 10 0	3 10 0
No. 3 G.M.B.	3 7 6	3 7 6
No. 4 Foundry	3 6 6	3 6 6
No. 4 Forge	3 6 0	3 6 0
Mottled	3 5 6	3 5 6
White	3 5 6	3 5 6
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 15 6	—
„ „ Foundry	3 19 6	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
Forge	3 11 0	—
(1) Derbyshire—		
No. 3 Foundry	3 18 6	—
Forge	3 14 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 13 6	—
No. 4 Forge	3 9 6	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	4 5 6 (*a*)	—
	4 8 6 (*b*)	—
	4 12 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 5 0	—
Second Quality Bars	8 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 0 0 to 9 7 6	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	12 15 0	12 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 17 6 to 8 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 10 0	—
Hoops	9 15 0 to 10 0 0	—
Soft Wire Rods	8 0 0	—
MIDLANDS—		
Small Rolled Bars	8 0 0 to 8 15 0	—
Billets and Sheet Bars	6 0 0 to 6 12 6	—
Galv. Sheets, f.o.b. L'pool	11 17 6	—
Sheets (30 W.G.)	16 7 6	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/- to 18/3
Block Tin (cash)	132 10 0
„ (three months)	134 10 0
Copper (cash)	47 2 6
„ (three months)	47 5 0
Spanish Lead (cash)	17 17 6
„ „ (three months)	17 16 3
Spelter (cash)	16 6 3
„ (three months)	16 8 9
MANCHESTER—	
Copper, Best Selected Ingots	56 0 0
„ Electrolytic	56 10 0
„ Strong Sheets	83 0 0
„ Tubes (Basis Price), lb.	0 1 0
Brass Tubes (Basis Price), lb.	0 0 11
„ Condenser, lb.	0 1 1
Lead, English	19 7 6
„ Foreign	17 17 6
Spelter	17 0 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/1 per lb.	
Ferro Tungsten	2/10 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 12 6	7/-
„ „ 6 p.c. to 8 p.c.	£22 10 0	7/-
„ „ 8 p.c. to 10 p.c.	£22 0 0	7/-
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£33 10 0	10/-
„ „ „ 1 p.c. carbon	£38 0 0	13/6
„ „ „ 0·70 p.c. carbon	£39 0 0	15/-
„ „ „ carbon free	11d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 15 0 for home	
„ „ „	£11 0 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	12/6
„ „ Ell	13/3
„ „ Splint	14/3 to 15/3
„ „ Trebles	12/- to 12/6
„ „ Doubles	11/6
„ „ Singles	11/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
„ „ Jewel	16/-
„ „ Trebles	12/6
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	10/3 to 12/9
Screened Navigation	16/6 to 17/6
Trebles	13/- to 14/-
Doubles	11/9 to 12/-
Singles	11/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	11/6
Secondary Steam	11/-
Trebles	13/-
Doubles	11/6
Singles	11/3

ENGLAND.

	Inland.	Export.
(8) N.W. COAST—		
Steams		20/6 to 22/-
Household		32/- to 51/-
Coke		21/- to 21/6
NORTHUMBERLAND—		
Best Steams		13/6
Second Steams		12/-
Steam Smalls		10/- to 10/6
Unscreened		13/-
Household		25/- to 37/-
DURHAM—		
Best Gas		15/6
Second		13/3 to 13/6
Household		25/- to 37/-
Foundry Coke		24/- to 28/-
SHEFFIELD—		
Best Hand-picked Branch	25/- to 26/6	—
Derbyshire Best Bright House	20/- to 22/-	—
Best House Coal	19/- to 20/-	—
Screened House Coal	17/- to 19/-	—
„ „ Nuts	15/- to 17/-	—
Yorkshire Hards	14/- to 15/6	—
Derbyshire Hards	14/- to 15/6	—
Rough Slacks	8/6 to 9/-	—
Nutty Slacks	7/- to 8/-	—
Smalls	3/- to 5/-	—
Blast-furnace Coke (Inland)	15/6 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.		17/- to 18/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	20/-
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/6 to 18/-
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/- to 18/3
Best Eastern Valley Large	17/9 to 18/-
Ordinary Eastern Valley Large	17/6 to 17/
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	12/6 to 13/-
Washed Nuts	17/- to 19/-
No. 3 Rhondda Large	20/6 to 21/-
„ „ Smalls	15/6 to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	16/- to 16/6
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	30/- to 37/-
Furnace Coke (Export)	25/- to 27/6
Patent Fuel	22/- to 22/6
Pitwood (ex ship)	26/3 to 26/9
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	28/- to 32/-
Red Vein	23/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	40/- to 46/-
Beans	24/6 to 27/6
Peas	20/- to 21/-
Breaker Duff	10/- to 10/6
Rubbly Culm	11/3 to 12/3
Steam Coals:	
Large	19/6 to 20/6
Seconds	18/- to 19/6
Smalls	12/6 to 13/6
Cargo Through	15/6 to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 12/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/- if home consumers confine purchases from associated British Steel Makers.

French Engineering Notes.

(From our Correspondent in Paris.)

Automatic Couplings.

WHILE at Geneva the committee formed to examine the proposal to equip continental trains with automatic couplings has been obliged to postpone further meetings until the beginning of next year, the French Government is preparing a Bill in favour of fitting such couplings on the French railways. So long as there is a reasonable chance of Geneva coming to a decision at an early date the French Government will do nothing until the type of coupling for international trains has been settled upon, but Government reserves to itself the right to begin the fitting of automatic couplings at home if Geneva fails to do anything within a period of two years. There are many difficulties in the way of providing a really satisfactory method of coupling up the coaches and the brake and steam heating tubes. None of the existing systems are approved of, particularly that in use in the United States, where the loss of life is proportionately nearly twice that in this country. The automatic couplings must be adapted to coaches with side buffers. At present the Boirault coupling is alone used on the Paris suburban electric trains. The estimated cost of fitting French coaches with automatic couplings is 2500 million francs, which will be spread over a period of ten years. The annual maintenance cost will, it is said, be more than 33 million francs. It will be met to a large extent by a reduction in the number of men employed and by a saving of indemnities paid for accidents. There is, nevertheless, said to be some danger of increased liability to accident during the transition period, since, with the fitting of automatic couplings the men may lose a sense of the risk they run when coupling up coaches without automatic devices.

Gas Congress.

The annual congress of the gas associations coincided with the opening of the new Maison du Gaz, adjoining the headquarters of the Société des Ingénieurs Civils, where the different associations will be centralised and professional courses for gas engineers will be held. The gathering was a particularly large one, with representatives from several countries. Many papers were read, and amongst those of general interest was one by Monsieur Pignot on the progress of motor traction with town gas. The gas companies are carrying out many tests and experiments in collaboration with the Société des Transports en Commun and other bodies, as well as with motor car manufacturers, and they have themselves devised gas and air controlling devices that appear to give satisfactory results. The work of the Gas Cylinders Research Committee in England aided the French companies in their investigations, and while in France the conditions of control are of a less exacting character, the gas companies are nevertheless satisfied that the cylinders they now use offer an ample margin of safety. The compression is from 2000 lb. to 2800 lb. per square inch in cylinders about 6ft. 2in. long and 8in. diameter. They have a capacity of 48 litres and weigh about 115 lb. Two motor omnibuses have been running in Paris on town gas stored in six cylinders, placed horizontally underneath, three on each side of the propeller shaft. The distributing system has a three-way cock to allow of the vehicle running on gas or petrol. The average consumption of town gas is 0·829 cubic metre and of petrol 0·458 litre per kilometre. The omnibuses run about 50 kiloms. on one charge of gas. Used in petrol engines with a compression of 5·4 the gas could not give the best results, and it is claimed that more economy was effected on Panhard charcoal suction gas lorries with sleeve valve engines working with a compression of 7. One advantage of gas for traction in towns is the very small quantity of carbonic oxide in the exhaust. Many difficulties have had to be overcome in order to make the use of town gas practicable for public transport, and Monsieur Pignot, who has carried out the experiments for the Paris Gas Company, affirms that it can now take its place as a national fuel. Professor Mailhe, whose name is associated with the catalytic production of petrol from vegetable oils, gave results of low-temperature carbonisation tests carried out with coal from three French collieries and from the Saar, and declared that while the process was particularly attractive, there were still the problems of transforming the heavy oils and phenols into products of higher value and of seeking the best means of utilising the semi-coke. The necessity of removing oil and water from tar used on roads led Monsieur Cabrier to devise a new installation at the Limoges gasworks. As the partial distillation of crude tar is notoriously troublesome and dangerous on account of the boiling effect due to the vaporisation of the water and oil, Monsieur Cabrier makes use of this effect by passing the crude tar through a large vertical cylindrical chamber communicating with a return pipe in the form of a syphon. The pipe outside the chamber is heated. The vapour blows the tar up through the pipe at short intervals, and, while the tar returns to the tank, the released oil and water vapour are carried away to a condenser.

Energy from Warm Water.

When last year Monsieur Georges Claude had the misfortune to see the tube, which he was laying in the Makansas Bay in Cuba, break and sink to the bottom, he returned to France with the intention of constructing a corrugated tube stronger than the previous one. It is now being immersed, and Monsieur Claude has cabled home to the effect that the work is proceeding satisfactorily. The tube has a length of about a thousand metres, and it will extend from the shore to a considerable depth where the temperature is something like 20 deg. Cent. lower than at the surface, and it is hoped that the experimental power station which has been installed in order to utilise this difference of temperature for the production of energy will prove the commercial value of the system in which Monsieur Claude and Professor Boucherot, his collaborator, have complete confidence. The cost of constructing, transporting and laying the tube is considerable, but it is declared to be more than justified by the fact that it will be possible to produce practically unlimited quantities of ice which will, it is stated, change entirely the aspect of tropical countries.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

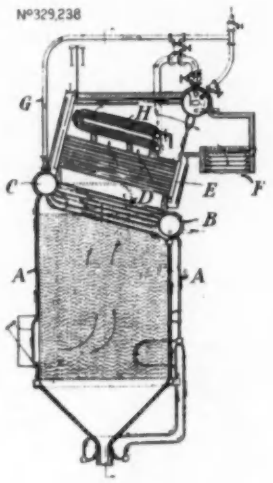
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

329,238. August 23rd, 1929.—WATER-TUBE BOILERS, *Babcock and Wilcox, Ltd., Farringdon-street, London, E.C.* 4.

This boiler is of the water wall type for burning powdered fuel. The tubes of the water walls are shown at A A and are connected with the drums B and C. These drums are, in turn, connected together by the bank of tubes D. Above this bank there is a standard water-tube boiler E. The products of combustion pass out through the economiser F. When starting up, steam will be raised in the water walls before it is made in the

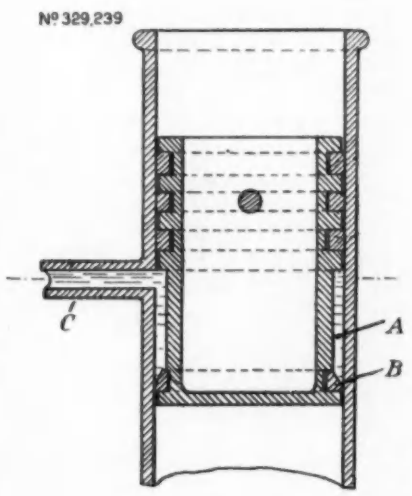


water-tube boiler. As a consequence, a connection G is made with the drum C, so that this steam can be taken directly to the superheater H and can be utilised until such time as the main boiler gets under way. In this way the superheater tubes are protected from being burned while starting up. Trouble is also obviated that might occur if the steam were permitted to enter the drum above a colder body of water and suddenly condense to cause severe bumping or water hammer.—*May 15th*, 1930.

INTERNAL COMBUSTION ENGINES.

329,239. August 29th, 1929.—PISTONS OF RECIPROCATING ENGINES, I. Berics, 384, Koprivnice, Czecho-Slovakia.

The inventor proposes to keep the cylinder walls free of dirt particles by adopting a special form of piston. The piston, it

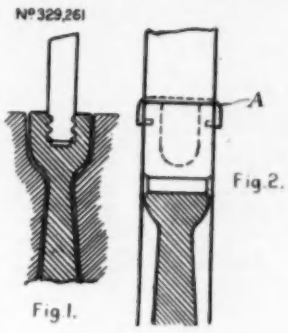


will be seen, has an annular space A cut around it." This space is sealed by a resilient ring B and is connected with a supply of compressed gas or liquid through the pipe C. This gas or liquid escapes past the ring B and sweeps away the particles of dirt.—*May 15th*, 1930.

TURBINE MACHINERY.

329,261. November 8th, 1929.—GAS TURBINE DISCS, Aktiengesellschaft Brown Boveri & Cie, Baden, Switzerland.

This invention appears to be primarily concerned with internal combustion turbines or with those using very high temperature steam. The object is to provide a maximum strength of rotor disc, with a minimum weight, at elevated temperatures. It is held that the blading of the turbine provides a heat-collecting medium, and that this heat will be conducted to the disc. If, say the inventors, the disc is formed as shown in Fig. 1, the heat may accumulate in the rim on account of the restriction of cross-sectional area, and abnormal stresses will be set up in the rim. So they make a hollow space in the rim between the adjacent

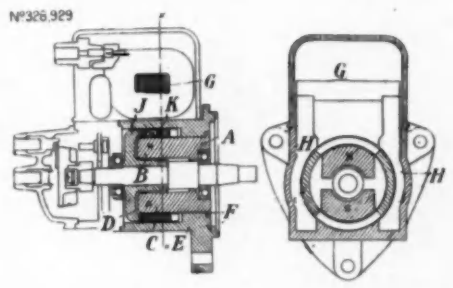


rows of blading, as shown in Fig. 2, and enclose this space with a light cover, as shown at A, for "fairing."—*May 15th*, 1930.

DYNAMOS AND MOTORS.

328,929. February 6th, 1929.—MAGNETO ELECTRIC MACHINES, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2, and L. Griffiths, Kennington, Biggin Hall-crescent, Coventry.

It is claimed for this magneto machine that it is more compact than the usual design. As shown in the drawing, an annular stationary magnet A is provided with two polar projections B and C, which fit closely into an aperture D formed in the main body casting E. The polar projections may be laminated if desired. The magnet may be provided with a flange F fitting into a recess in the casting and may be prevented from rotating by means of dowel pins or screws securing the flange to the cast-

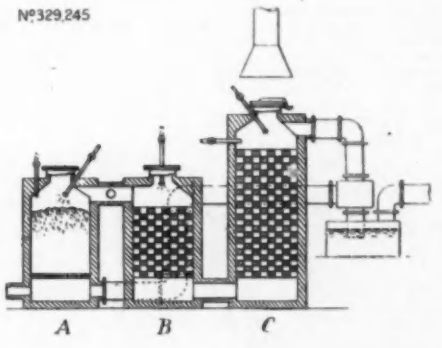


ing. A stationary armature G is mounted on the upper side of the body casting and is provided with poles H projecting downwards towards the fixed magnet pole pieces. Interposed between the armature poles and the magnet pole pieces is a rotatable sleeve inductor which comprises a casting J of aluminium or other suitable non-magnetic material, into which laminated segments or pole-pieces K are cast. These pole-pieces co-operate with the magnet and armature poles to give four reversals of flux through the armature core. A distributor and a contact breaker are arranged at the end of the driving shaft on which the inductor sleeve is mounted and which is preferably of non-magnetic material.—*May 6th*, 1930.

GAS PRODUCERS.

329,245. September 11th, 1929.—PRODUCTION OF MIXED OIL GAS AND WATER GAS, *Humphreys and Glasgow, Ltd.*, 38, *Victoria-street, Westminster.*

In this process of gas production the fuel is partially consumed in the generator A by means of an air blast and the products of combustion pass through the carburetter B and superheater



C. Heat is consequently stored in those vessels. Oil is then injected into the carburetter and the resultant gases and vapours are returned to pass through the fuel bed in the generator. In their passage they are cracked and a certain amount of carbon is deposited in the bed. This carbon is then burned away by the admission of steam and the consequent production of blue water gas.—*May 15th*, 1930.

MACHINE TOOLS AND SHOP APPLIANCES.

329,241. September 5th, 1929.—METHOD OF MAKING SCREW THREADS BY GRINDING, H. Lindner, 57–58, Fruchtstrasse, Berlin, O. 17, Germany.

In making screw threads by grinding, one of two methods is usually pursued. Either a single-ribbed grinding disc is employed, which is tilted in accordance with inclination of the screw thread, or a multi-ribbed disc is used which must then be held with its axis parallel to the screw. In the first instance, the feed of the blank relative to the disc must be very slow, and the method is, therefore, time-wasting. In the second instance, owing to the parallelism of the axes and the inclination of the thread, the latter will be mis-shaped. The object of the invention is to remedy both defects, and the invention consists in grinding the screw roughly by means of a multi-ribbed disc

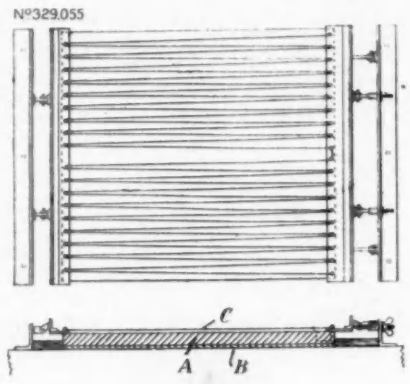
arranged with its axis parallel to that of the blank, and finishing the screw by means of a single-ribbed disc which is tilted in conformity with the inclination of the thread and which is adapted to rectify the thread as regards its shape. In this manner both stages of the grinding process can be carried out in a very short time while a perfectly shaped screw thread is obtained. The finishing rib has the exact shape of the thread groove and is curved off outwards at the root for shaping the tops of the threads. A single machine may be used for carrying out both stages of the process, one grinding disc being exchanged for another between the two stages. If two machines are used, one for the rough and the other for the finishing grinding, the chucks and also the work must be provided with index marks, or other means must be employed for ensuring a correct and rapid positioning of the work relative to the tools of the two machines. When screw taps are made in this manner, the backing-off of the tap may be effected after the rough grinding by means of either grinding disc, which, for this purpose, is fed towards or away from the axis of the tap as the grinding proceeds from one edge to the other of each land. In order to save the single-ribbed disc, however, the backing-off can be carried out by means of the roughing disc since the backed-off parts will have no influence on the screw thread made by the tap. The rough-grinding disc is preferably provided with as many ribs as the screw is to have turns of thread, it being thus possible to complete the roughing of the screw during one feed revolution of the same.—*May 15th*, 1930.

LIGHTING AND HEATING.

329,055. February 25th, 1929.—ELECTRICAL HEATING OF BUILDINGS, R. Grierson, 4, Bloomsbury-place, London, W.C. 1, and Grierson, Ltd.

This invention is concerned with the manufacture of electrical heating panels for the rooms of buildings. The panels are built up of a slab of cork A, which is stiffened by an asbestos-cement

Nº329,055



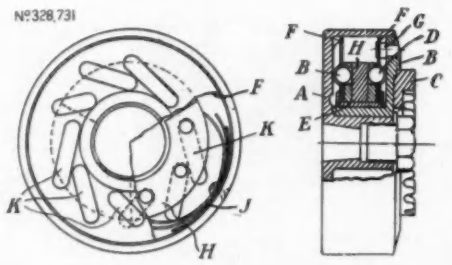
backing B to prevent the backward radiation of heat. On the front of the slab there is wound a resistance wire C, which is not in contact with the cork slab. The surface is then floated over with cement which just covers the wire and holds it in position. The specification describes the process of manufacture in detail. —*May 15th*, 1930.

MOTOR CARS AND ROAD TRAFFIC.

328,731. March 13th, 1929.—AUTOMATIC ADVANCE AND RETARD IGNITION DEVICES FOR MAGNETO-ELECTRIC MACHINES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London W.C. 2; Cecil James Morton, "Stanway," Wainbody-avenue, Greenlane, Coventry; and Thomas Henry Woodfield, 85, Addison-road, King's Heath, Birmingham.

This specification describes an automatic advance and retard ignition device, for magneto-electric machines, of the kind in which the movement of a number of weights under the action of centrifugal force is utilised to effect relative movement between a driving member and a driven member. The driven member A is in the form of a plate having a boss secured to the magneto shaft, and the driving member B is also constituted by a plate having a boss surrounding the boss on the driven plate and capable of angular displacement relatively thereto. The driving plate also carries a coupling member C, through which the drive is transmitted from the engine with which the magneto is associated. Between the driving and driven plates there is a cage member E comprising two annular walls connected by a sleeve which surrounds the boss on the driving plate. The walls of the cage are in the form of pressed metal plates F and are so arranged

Nº328,731



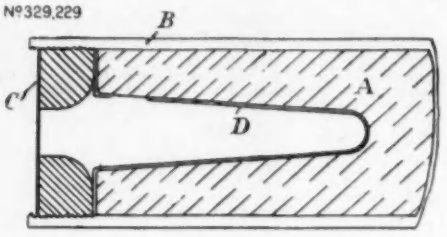
as to be capable of angular displacement relatively to one another. The plates constituting the walls are connected by means of pins G to the driving and driven plates respectively. Mounted within the cage are three equal weights H, each constituting a portion of an annulus, these weights being disposed around the sleeve portion of the cage in such a manner that when they are in their innermost position their ends touch, and they form a complete annular body concentric with the sleeve. The weights are normally maintained in this innermost position by means of suitably disposed springs J, carried by an outer wall of the cage, formed by the driven member. Each weight carries a number of balls D projecting from either side, and these balls engage with depressions or slots K formed in the walls of the cage, these depressions being so directed that as the weights move radially outwards the walls of the cage are caused to turn relatively to one another in opposite directions. In operation, as the weights move out radially under the action of centrifugal force, the balls by their engagement with the depressions or slots in the walls of the cage cause these walls to be angularly displaced relatively to one another, the walls, in turn, causing a corresponding displacement of the driving and driven plates.—*May 8th*, 1930.

ORDNANCE AND ARMOUR.

329,229. July 19th, 1929.—ROCKETS, E. F. Spanner, 13, Shooter's Hill-road, Blackheath, London, S.E. 3.

This invention is concerned with that type of rocket used for line-throwing in connection with life-saving apparatus, and has for its object the provision of a rocket which is not liable to

Nº329,229



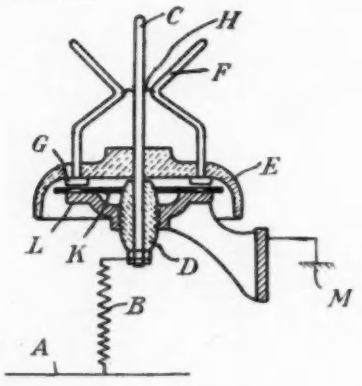
mechanical damage. The propellant A is contained in a steel tube B, which is closed by a "choke" C. A diaphragm D, of celluloid, or some such material, is formed within the charge of propellant and serves to protect it from atmospheric changes and accidental derangement. The diaphragm may be perforated to facilitate the ignition of the charge.—*May 15th*, 1930.

MISCELLANEOUS.

328,839. June 6th, 1929.—SURGE PROTECTION ARRANGEMENT FOR ELECTRIC PLANTS OF LOW OPERATING VOLTAGE, Maschinenfabrik Oerlikon, of Oerlikon, near Zürich, Switzerland.

This invention relates to a surge arrester for electric plants of low operating voltage. A denotes the line to be protected; B a non-inductive limiting resistance; C a metal bolt passing through and mounted in an insulator D, and passing through an insulator E, the bolt being connected to the line A through the resistance B. F are metal horns, which are disposed concentrically in relation to the bolt and are secured in the insulator

Nº328,839

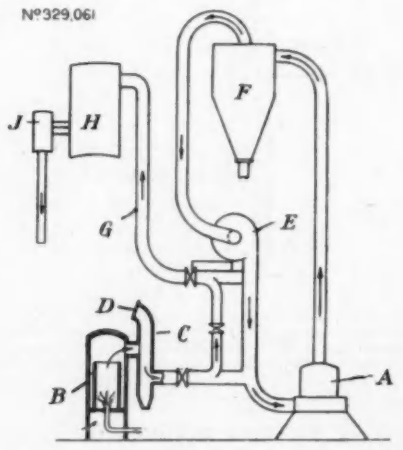


E, and provided at their lower ends with electrodes G; H are fuses connecting the members C F. K is an insulating spacer disc provided with holes underneath the electrodes G. The insulator E can be taken off with the horns F, from the support L, so that the disc K can be exchanged. The support consists of metal and is earthed at M. The device operates as follows:—The excess voltage surge occurring in the line A strikes over between the electrodes G and the support L. The earthed current fuses the corresponding fuse wire H, whereby the current is interrupted. The excess voltage has in the meantime been diverted or damped.—*May 8th*, 1930.

329,061. March 1st, 1929.—PULVERISING MILLS, International Combustion, Ltd., Africa House, Kingsway, London, W.C. 2, and F. H. Rosencrants.

In this process of pulverising coal a supply of hot air is provided to dry the coal as it is disintegrated in the pulveriser. The pulveriser is shown at A. Air is first heated in a furnace B and is then drawn forward through the safety chamber C. This chamber is fitted with a door D. The draught

Nº329,061

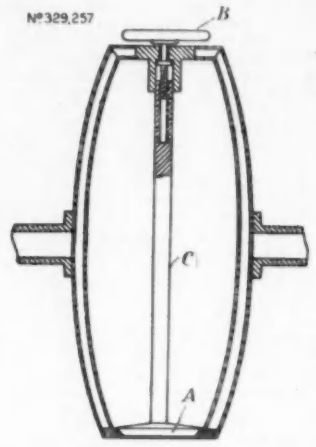


necessary for operation is provided by the fan E, which sucks through the cyclone separator F. A part of the air circulating round the system is by-passed through the duct G, and separator H, and is discharged to atmosphere by the fan J. In this way the humidity of the air is reduced sufficiently to enable the drying to proceed. Valves are arranged in appropriate positions for controlling the proportions of air in circulation and that discharged.—*May 15th*, 1930.

329,257. October 4th, 1929.—DOORS FOR ROTARY DIGESTERS, Dr. Ing. Siller and Rodenkirchen Gesellschaft mit beschränkter Haftung, Rodenkirchen-on-Rhine, Germany.

It is suggested in this specification that the usual arrangement of charging and discharging doors for digesters involves the sacrifice of considerable space for the accommodation of their

Nº329,257



fastenings. As a consequence, the inventors adopt a valve-like closing door A, which is operated by the screw and hand wheel B in connection with a lenticular digester. It is claimed that the hand wheel need not project beyond the general contour of the digester and that the stem C acts as an agitating member for the contents of the vessel.—*May 15th*, 1930.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South Midland District meeting to be held at Harpenden. Assemble at Public Hall, The Common, Harpenden, 11 a.m.; 11.20 a.m., inspect the road widening scheme, Piggottshill-lane; 11.40 a.m., visit the sewage disposal works; 12.30 p.m., luncheon at the Trust House, Cock Inn, High-street; 2 p.m., inspect the new 350,000-gallon reinforced concrete water tower and tank of the Harpenden Water Company; 2.30 p.m., inspect the new pumping station of the Harpenden Water Company near The Hyde; 3.30 p.m., return to Harpenden to inspect the new concrete road in course of construction on the housing site; if time permits, the new cemetery adjoining may be inspected; 4.30 p.m., tea at the Public Hall; a paper descriptive of the road works and sewage disposal works will be given by the Engineer to the Council, Mr. W. H. Johnson. Discussion after tea.

TO-DAY TO WEDNESDAY, JUNE TO 25TH.

SECOND PLENARY WORLD POWER CONFERENCE.—In Berlin.

SATURDAY, JUNE 21ST.

INSTITUTION OF ENGINEERS-IN-CHARGE.—Visit to the National Physical Laboratory, Bushey House, Teddington. 3 p.m.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—Newcastle-upon-Tyne. "The Pitman's Yearly Bond," by Prof. Henry Louis; "The Surveying of Boreholes," by Mr. J. T. Whetton. 2.30 p.m.

SATURDAY TO SATURDAY, JUNE 21ST TO 28TH.

ROYAL SANITARY INSTITUTE.—Congress and Health Exhibition at Margate.

TUESDAY, JUNE 24TH.

ADVERTISING CONVENTION, 1930.—Industrial Press Session Luncheon, Royal Victoria Hotel, Hastings, after which a number of speakers will give their views on various matters connected with the trade and technical Press:—Professor Henry Clay, "British Industry's Message to the World;" Mr. Holbrook Jackson, "The Voice of Industry—the Trade Press;" Mr. C. Pinkham, "The Service Expected from a Trade Journal;" Mr. P. Best, "The Trade Journal as a Link between Manufacturer and Distributor."

WEDNESDAY, JUNE 25TH.

INSTITUTION OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—Visit to the works of the Derbyshire Silica Firebrick Company, Ltd., Friden, Hartington, near Buxton. Assemble at Stevenson-square, Manchester, at 2 p.m.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Visit to Barnsley Waterworks. Meet at Scout Dike Reservoir (on the Penistone-Huddersfield Road, about 1½ miles from Penistone). 11.30 a.m.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.—Visit to Port of Bristol.

FRIDAY, JUNE 27TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Meeting at Wandsworth and Heston Air Park. Assemble at Streatham Baths. 10.45 a.m.

MONDAY TO FRIDAY, JUNE 30TH TO JULY 4TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Summer Meeting at Bristol.

WEDNESDAY TO WEDNESDAY, SEPTEMBER 3RD TO 10TH.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—Bristol meeting. The presidential address, by Professor F. O. Bower, will deal with "Size and Form in Plants." Evening discourses will be given by Professor E. V. Appleton, F.R.S., on "Wireless Echoes," and by Dr. R. E. Slade on "The Nitrogen Industry and our Food Supply." Evening receptions and excursions to points of scientific interest, works, &c., in the locality will be arranged.

THURSDAY TO SUNDAY, SEPTEMBER 4TH TO 7TH.

INTERNATIONAL CONGRESS OF CONSULTING ENGINEERS.—Fifth Congress at Vienna.